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ELECTION '92

Push Comes to Shove on Technology Policy

ALSO:

*Workers
(and Managers)
of the World Unite*

Of Bytes and Rights

*Chinese Herbs:
A Bitter Pill for
Western Medicine*

*Edward O. Wilson
on Biodiversity*



technology review

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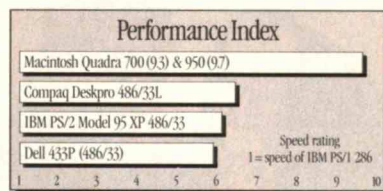
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the 700 and the 950 to accommodate the largest CAD files. And the 950 even lets you add a CD-ROM drive or a removable cartridge drive, and a disk array or more than a gigabyte of internal hard disk storage.

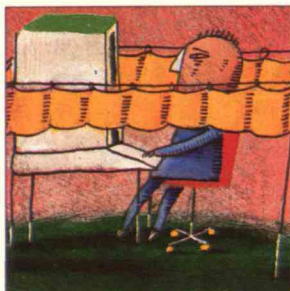
You can increase the memory of the 950 to up to 64MB of RAM for handling compute-intensive applications like three-dimensional modeling and stress analysis.

Over your network, the unique Apple interapplication

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CREATIVE SOLUTIONS for Improved GLOBAL COMMUNICATIONS

Global communications has led to global economics, global manufacturing and trade. In turn, this global interdependency demands improved

**'92
RoBoCon**
INTERNATIONAL DESIGN CONTEST

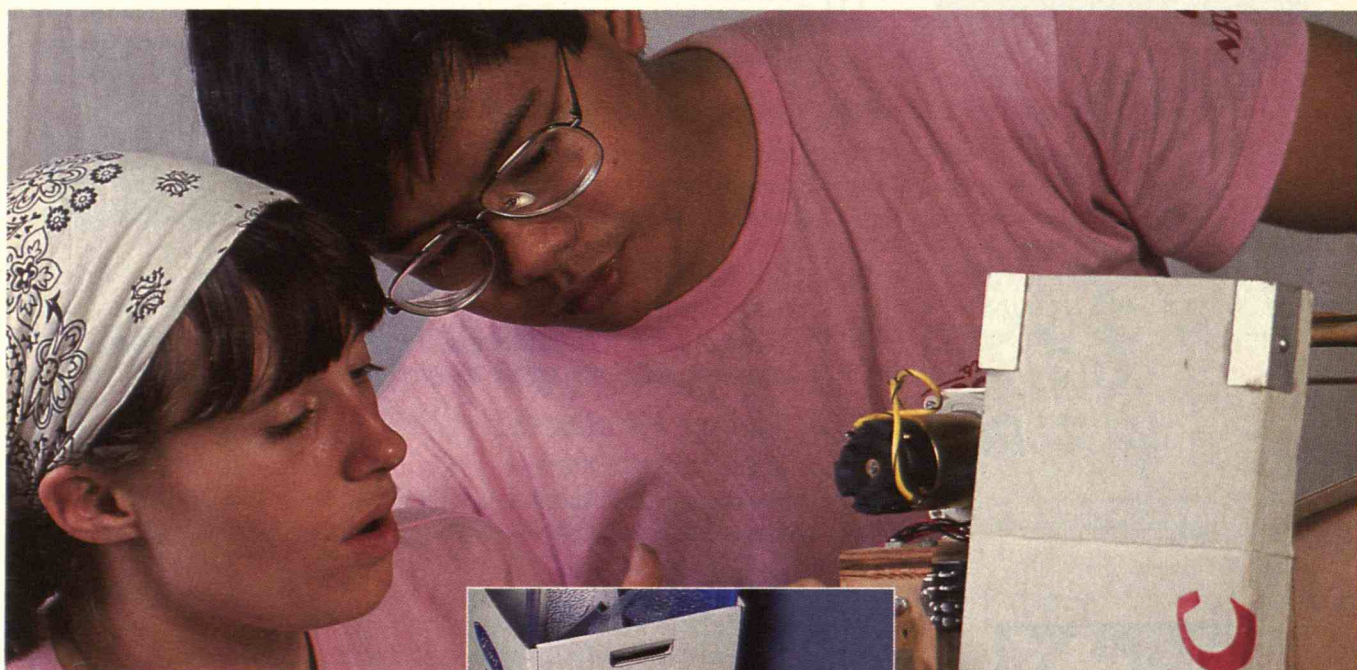
communication across cultural and language barriers.

Recently, a group of students from around the world gathered at the Massachusetts Institute of Technology to



take part in RoBoCon International Design Contest '92, an experiment in cross-cultural communications.

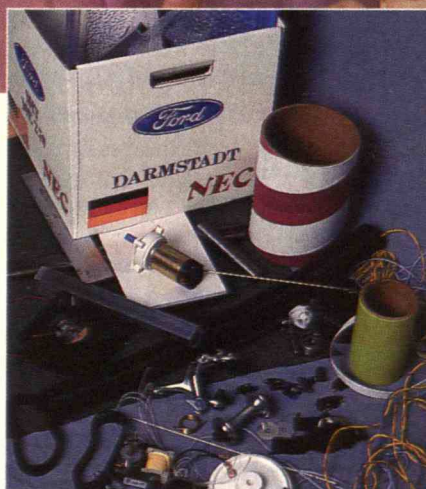
Forty engineering students, 10 each from the U.S., Japan, the United Kingdom and Germany, were given six



days to solve an engineering challenge — move table-tennis balls from a platform, down a ramp and into a raised cylinder.

The task had to be accomplished by using robots built by the students from a box of parts which included electric motors, pneumatic actuators, wheels from toy trucks, printed circuit boards, steel bars, welding rods, plastic tubing — more than 100 parts in all. At the end of the sixth day the completed machines would face off in a contest to determine which robot could gather the most ping-pong balls in a minute.

So, what's this got to do with global communications? The students worked in teams of four — each



consisting of students from the U.S., Japan, the U.K. and Germany. Solving the engineering problem would be hard enough. The real challenge would be finding ways for team members to communicate among themselves.

"RoBoCon IDC is a microcosm of the future," says Professor Herbert Birkhofer of Technische Hochschule Darmstadt, Germany. "The challenges presented by a global economy will require close cooperation by professionals, not just engineers, from all over the world." His colleague and friend, Professor Masashi Shimuzu, of the Tokyo Institute of Technology, adds, "RoBoCon IDC is more than a mere competition between engineering students; it's an experiment in developing cross-cultural methods of communicating and cooperating."

Shortly after being issued their parts kits, the newly formed teams gathered to plan and discuss strategy.

"Very early on, the students realized that simply talking to one another wasn't going to work," explains Ken Wallace of Cambridge University. Professor Harry West of MIT adds: "But studies have found that in many engineering projects more than half of what engineers do is talk to one another. When they are of the same culture, the culture is transparent. But when they're not from the same culture, it can be near impenetrable. Our students had to find other ways of communicating." In short order talking gave way to sketching and sign language. "There was a lot of drawing and waving of arms," laughs one engineering student from Cambridge.

Primary in the mind of the

students, however, was solving the problem. Because of the drop in elevation, developing a ramp system of some kind to roll the table-tennis balls down into the cylinder was irresistible to more than half the teams. "It was the obvious solution, but not the elegant solution," says an MIT student. "We wanted something that was different, creative," added his teammate from the Tokyo Institute of Technology. "The team went on to design and build a machine that gathered up the balls, flung them up to a raised platform, and then rolled them off so that they could

bounce with a graceful arc into the cylinder.

"Creativity is what RoBoCon IDC is all about," says Professor West. "In this case, there's an added dimension of learning how to communicate. If

anyone can come up with creative solutions, it's these students."

Cultural Obstacles and Creative Communication

An MIT

student from Mexico City notes, "Sketching and sign language were very useful for getting our points across, but where we really made progress communicating was during free time. Having a beer at a pub, going to the



beach or having dinner together gave us a chance to learn more about each other and the way we think and communicate. Getting to know each other made all the difference. Somehow, we developed our own way of communicating that seemed so perfectly natural."

For six days, the basement shop at MIT was a model of inter-cultural communication with a parade of innovative — and sometimes outrageously clever — designs from some of the best young engineering minds

the world has to offer.

"At times I've worried about the future," says Ken Wallace. "Since seeing the way these young people get along, I've been sleeping better than I have in years."



Who won? In the sense, we all did. For at RoBoCon IDC '92, 40 very bright and creative students laid the groundwork for developing improved global communications. NEC, a global leader in computers and communications, strives to help advance societies worldwide toward deepened mutual understanding and fulfillment of human potential. NEC was a proud sponsor of RoBoCon IDC '92 and its quest to foster communication and creativity in our young generation.

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Dismantling Barriers to Economic Progress

CONSTANT renewal is now essential for companies' survival in global markets where product lifecycles are often only 24 to 36 months long. But in the United States we hold ourselves back from such renewal with too many self-imposed barriers.

Among the most significant of these barriers are federal antitrust laws. These 100-year-old statutes provided protection during an age gone by, but now—at least at the international level—they are a straitjacket. Recognizing this, Congress passed in 1984 the National Cooperative Research Act, which has since allowed several hundred consortia, involving several thousand companies, to undertake joint R&D.

Two good examples are both located in Austin, Texas. MCC (the Microelectronics and Computer Technology Corp.) is a consortium of about 80 companies that conducts some 35 research projects simultaneously, usually with three to ten companies participating in each project. And Sematech is a partnership between industry and the Department of Defense focused on R&D in advanced semiconductor manufacturing technology.

These collaborative enterprises have begun bearing fruit. Sematech, for example, recently devised new chip-making machinery—"steppers"—to enable development of a 256-megabit chip that is years ahead of Japanese technology. This achievement, which may permit the United States to recapture the mass-memory portion of the semiconductor market, demanded resources that could not likely have been accomplished by any one company acting alone.

MCC, Sematech, and other such research-oriented consortia are a step in the right direction. But additional laws are needed that permit collaborative production, which companies in virtually all other industrialized countries are allowed by their governments to pursue.

To be competitive, we need greater sharing of resources by American companies in industry-led, industry-managed consortia, partially supported by federal funding and involving our university and government laboratories. Such collaborative efforts could run the gamut from basic discoveries, through development and scale-up, to joint manufacturing operations.

Enormous opportunities would thus be created for making a continuous stream of innovative products in a great

*Government
must permit, even help
to support, across-the-board
industrial collaboration.*

variety of industries. Here's one example: During the first two minutes that a car is running, the catalytic converter begins to warm up but does not function at full efficiency. As a result, according to the California Air Resources Board, 80 percent of automobile pollution occurs at that time. A preheater on the converter, now mandated in 11 states, will greatly decrease auto emissions. But given the universal applicability of this device, why should each automobile company, so to speak, "reinvent the wheel?" Cooperative manufacturing of the preheater would render the product more economical to make, decrease its price, improve productivity, and benefit the environment.

Here's another example: Over the past 20 years, our nation's machine shops have become less and less competitive with their counterparts overseas. We could reverse this trend by allowing them to share flexible computer-integrated manufacturing facilities, which would provide both rapid prototyping and quicker entry into the marketplace for new products, as well as the ability to continually modify and upgrade existing products. Members of such a consortium would have priority access to these

facilities, but other companies could buy time on them as available. Or they could start their own in competition.

The range of possible consortia, whether in terms of industry type or institutional structure, is enormous. And all have the potential to deliver the goods. But incentives such as investment tax credits and accelerated depreciation allowances are needed to nurture their growth.

We especially need to revise antitrust laws that were once protective of domestic competition—and should remain so—but that have the ironic effect of stifling it for the United States in the new global marketplace. These days, it takes collaborative effort to move the results of basic research up through the actual manufacture of products.

No other country approaches our potential for technological leadership, because no other country approaches our overwhelming capabilities. Our commitment to basic research comes to almost \$25 billion annually. (Great Britain is second highest with less than 10 percent of that amount.) We have more trained scientists, 4.5 million, and more companies, 15 million, than any other country.

No competitor can claim such depth and diversity of industrial competence. We also have the world's largest market with a common language and an entrepreneurial culture that allows failure without devastating personal or social penalty.

With a few thoughtful and well-directed actions by Congress and the White House—both to pass enabling legislation and to simply get out of the way—we can dismantle the roadblocks and resume leadership in virtually all technology-based industries. ■

—D. BRUCE MERRIFIELD

The author is a professor of management at the University of Pennsylvania's Wharton School of Business. During Ronald Reagan's administration, he was assistant secretary of commerce for productivity, technology, and innovation.

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Letters

HIGHWAYS IN TRANSITION

"The Case for Smart Highways" by Moshe Ben-Akiva, David Bernstein, Anthony Hotz, Haris Koutsopoulos, and Joseph Sussman (*TR July 1992*) is an excellent primer on intelligent vehicle/highway systems, or IVHS. But it does include a few misleading comments.

First, the authors say the \$200 billion, 20-year IVHS investment would benefit society better than upgrades in mass transportation because "Americans are too committed to automobiles to expect massive shifts away from the car." In fact, the mass-transportation movement is growing in this country. From California to Florida, planners are noticing that people are starting to prefer mass transit to cars.

I am also not sympathetic to the suggestion that IVHS "involves fundamentally reshaping the country's transportation system," whereas transportation options like maglev don't. I am not without my own biases. In my current position supporting the National Maglev Initiative, I attribute all sorts of benefits to maglev that others might not endorse. However, I do not build the case for maglev by downplaying the competition. There is a place in the future for advanced transportation options, of which maglev is just one—as is IVHS.

LAURENCE E. BLOW

Argonne National Laboratory
Center for Transportation Research

Dreaming of a high-tech Tomorrowland that transforms the highway system not only defers the problem but accentuates it. No vision of fast-lane technology can stem the runoff, salt, and other pernicious consequences of roadmaking that have helped erode our natural landscape. No car-based solution will end the loss of context and community that we bemoan. "Smart highway" is an oxymoron. A car-centered fix to car-caused problems will only be undermined by increasing car miles, as it has been in the past.

Instead of investing in IVHS, we need to reinstate the automobile as a partner in a human-based landscape—the land-

scape many of us grew up in. That means altering the post-World War II pattern of sprawl bred by federal highways and federally financed mortgages to one focused on walking, one with a sense of place.

We need to mend the center city, make the suburbs already built more than just bedroom communities, and stop exurban spread. Even at the supposedly desultory rate of 1 million new houses a year, these new structures, many of them on large single lots, are land-depleting and auto-coddling. Some architects have begun to counter that trend by offering what they call "pedestrian pockets" or "neotraditional towns"—new kinds of planning that use zoning and design guidelines to enforce an ease of movement on foot. Such compact patterns could free us from the automobile for many of our needs and enable us to reach mass transit for the rest.

We must make the most of older, more urban communities built before the automobile. We have a heritage of walkable towns, of streetcar suburbs and cities. They hold a vast and lively range of housing types—multifamily wooden structures and brick row-houses, for instance. To revive these bypassed places is essential. It means more flexible zoning. It also means a social policy attentive to concerns such as local jobs and schools—concerns vital to those who wish to make a real life for themselves in the communities. By accentuating mass transportation and inserting a connective tissue of sidewalks or bikeways and clustered transit stops in such places, we can lessen auto-dependence still more.

In short, we must redefine mobility down to a three-mile-an-hour scale, fostering the capacity to cross the street, to use the sidewalk. We need to have mid-block passageways, liberated streets, longer stoplights, narrower roadways. Then we need to enhance the things that encourage travel on foot, looking at step height, street furniture, city trees, and shop windows.

Our transportation system is a tangle; our landscape is strangled by the umbilical cord of the car. More of the same isn't smart.

JANE HOLTZ KAY
Boston, Mass.

Ms. Kay, architecture critic for the Nation and Landscape Architecture, is writing Carbound: Ending the Auto Age.

ANIMALS' QUALITY OF LIFE

Tabitha M. Powledge's "Gene Pharming" (*TR August/September 1992*) does not give sufficient weight to concern about animal well-being. Powledge does note that "most animal biotechnologists believe the public would be repelled by a drug from slaughtered animals," but I do not think this accurately summarizes the problem. If it were possible to prevent 20,000 deaths from emphysema by slaughtering 20,000 sheep per year for a drug, the overwhelming majority of Americans probably wouldn't mind. Our food industry currently slaughters far more mammals to less dramatic benefit.

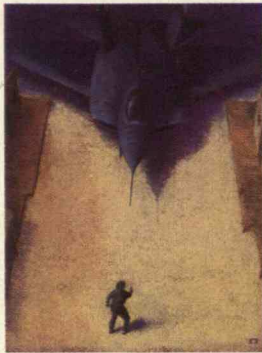
The real issue is not animal deaths but the lives animals lead. Animals genetically engineered to produce drugs might have highly specialized nutritional needs that would make them less likely to lead healthy and satisfying lives. Gene pharming could face a public backlash unless it soon demonstrates that it can avoid such hazards.

GARY VARNER
Center for Biotechnology
Policy and Ethics
Texas A&M University

IN DEFENSE OF THE F-22

The arguments advanced in "The F-22: An Exercise in Overkill" by David Callahan (*TR August/September 1992*) are reminiscent of those that swirled around some key defense projects in the early to mid-1970s.

For example, jaws dropped at the proposed price tag of the F-15 fighter aircraft. One of the main arguments against the craft was that we would be better off



refurbishing the F-4 Phantom, and to support this argument, many analysts relied on cost-effectiveness analyses in which they had tried to find some nice, objective number that could be plugged into an equation to tell them how worthwhile a combat aircraft might be. But as I discovered when I personally learned to fly, many important differences in aircraft are subtle. The F-4, it turned out, was a slow-turning, smoky dog that could not be effectively upgraded, owing to inherent airframe limitations. The F-15 airframe was far superior. Not only that, but it had a longer effective life and future upgrade capability. We would have made a serious mistake if we had gone ahead and attempted to prolong the life of the F-4 as a top-of-the-line fighter.

But even the F-15 airframe has its limitations, especially now that it's getting old. In fact, regarding top-of-the-line fighters in general, I have come to the conclusion that no amount of refurbishing old airframes will do the trick. Airframes tend to lose their qualitative edge long before they are actually worn out; even with renovated power plants, they simply don't have the aerodynamic efficiency to do their job well.

I believe the most workable strategy is to invest in the best possible aircraft to establish our air superiority and, at the same time, refurbish other aircraft for use as strike bombers. In other words, we should go ahead and build the F-22 and gradually convert the quite capable F-15 and less capable F-16 to strike/attack roles. This will probably maximize the effectiveness of our tax dollars while maintaining a strong defense.

JOSEPH L. KASHI
Soldotna, Alaska

SUNUNU'S OPTIMISM

In "The Political Pleasures of Engineering" (*TR Interview August/September 1992*), John Sununu takes a number of groups to task for their responses to greenhouse warming. He speaks of "broad disinformation" and "misinformed, emotionally inclined decision making." Given some of Sununu's arguments, this sounds like the pot calling the kettle black.

In particular, Sununu makes much of a recent report from the American Geophysical Union, which, according to him, concludes that the eruption of Mount Pinatubo in the Philippines last year will delay dangerous levels of global warming by at least 20 years. But what that report actually states is that the volcanic effect of Mount Pinatubo will last "only a few years."

Sununu also echoes the oft-repeated notion, now bordering on dogma, that we shouldn't act on the basis of bad data and bad models since good ones will soon be available. However, what we know about the real world and about the problems of simulating it does not support his optimism. The first platform of the NASA Earth Observing System program, designed to gain crucial information about many climate processes, is not due for launch until 1998, and definitive results won't come for some years after that. The acoustic sounding experiment to measure ocean temperatures, which offers the best hope for determining how effective the oceans are in delaying global warming, will not gather the necessary information before about 2005. No firm plans are in place to monitor many other key climate variables, such as global precipitation and water vapor concentrations. Without these data, it will not be possible to validate or improve many key aspects of climate models.

Moreover, even with a wealth of information to go on, models to predict the extent of global warming are likely to remain controversial until we know from our own experience that their forecasts are correct. People will draw their

Continued on page 79

MIT Reporter

MAPPING THE MALE CODE



The first full map of the human Y chromosome is now complete, opening the way for detailed study of the genetic system that triggers the differences between the sexes.

"People can now think about asking what were previously unreasonable questions" about the chromosome and its relatively small complement of genes, says David C. Page, an assistant professor of biology at MIT and molecular biologist at the affiliated Whitehead Institute for Biomedical Research.

Such research may help show what genes reside on the Y chromosome and how they participate in the elaborately choreographed events that build and maintain the human body. Also, Page says, study of the Y chromosome may help unravel some of the mysteries of human male evolution, since only men pass along that chromosome to their sons.

The Y chromosome map, recently published in *Science* by Page and his colleagues, covers about 1 percent of the human genome, the encyclopedic set of chemical instructions that directs how the human body is put together. The human genome contains up to 100,000 genes scattered among 3 billion DNA "base pairs," or linked units of the four basic chemicals that make up DNA.

Scientists are avidly pursuing similar maps of the other human chromosomes as part of the four-year-old Human Genome Project (HGP), the biggest biology research program ever undertaken. In fact, an international team led by Daniel Cohen of the French research institute Genethon and the *Centre d'Etude du Polymorphisme Humain* announced almost simultaneously with the Page publication that they have mapped human chromosome 21. When duplicated abnormally, that chromosome is the cause of Down's Syndrome, and seems to carry the gene for an inherited form of Alzheimer's disease. The



A research team headed by David C. Page of MIT and the Whitehead Institute has mapped the human Y chromosome, which appears fully fluorescent in this image. One Y chromosome has been rendered visible on its own; others are still contained within cells' nuclei.

HGP, expected to cost about \$3 billion, aims to identify the order of every base pair in the human genome by the year 2005.

The newly created map of the Y chromosome breaks down a total of 35 million base pairs into sections that are each about 600,000 base pairs long. While that level of detail isn't fine enough to show individual genes, it still represents an important achievement. Completion of the map indicates that "the techniques we're developing can really do the job," says biologist Theodore Friedmann of the University of California at San Diego. "The pace is faster than most of the practitioners expected." This suggests that the HGP may be completed on schedule, which some observers have previously doubted.

Many genome researchers are begin-

ning to use some of the new methods employed by Page's group to break down a chromosome into manageable, identified pieces. The team, including Simon Foote, Douglas Vollrath, and Adrienne Hilton, first identified on the Y chromosome "markers"—short lengths of DNA within longer DNA chunks. They next constructed artificial yeast chromosomes (YACs) by attaching critical sections from the ends and centers of real yeast chromosomes to the segments of human DNA. The group then inserted the YACs into other yeast cells; growing the yeast in a nutrient broth caused the human DNA to be reproduced in huge quantities. YAC technology was invented by biologist Maynard Olson while he was at Washington University in St. Louis.

Page's team prepared each YAC so that its ends overlapped adjoining YAC segments, insuring that no part of the chromosome was left out. Page's team developed a "library" of 150 contiguous YACs. "It's like a puzzle whose pieces are the YACs," Page explains, with each piece of the puzzle marked to show where it fits. Laid out in sequential order, the YAC library is ready for researchers who want to select portions for chasing down individual genes.

Biologist Francis Collins, a leading gene researcher at the University of Michigan, calls the detailed mapping "impressive" because Page's team "did it without much in the way of fancy technologies." The group did not need to invent new instruments.

Page began studying the Y chromosome in 1981 while working with former MIT geneticist David Botstein, now at Stanford University. Page took advantage of rare cases of abnormal sexual development—females with XY chromosome arrangements and males with XX chromosomes—to gradually dissect the Y chromosome. Normally, people who inherit a Y chromosome end up with male sexual characteristics. Individuals lacking a Y chromosome almost

always develop as females. Page became a leading contender to pin down the one gene that orders an embryo to develop as a male. The race was won, however, by biologist Peter Goodfellow and his colleagues at the Imperial Cancer Research Fund in London.

Now researchers are trying to clarify just how that "maleness" gene causes male development. Many scientists have long believed that the gene makes a protein very early in development that tells the embryo to grow testes instead of ovaries. But Goodfellow, now at Cambridge University in England, says that the opposite may be true: the gene may send out a negative signal, one that shuts off a pathway that leads toward being female. Instead of "turning on" maleness, the Y chromosome may turn off femaleness. —ROBERT C. COOKE
(The author is a science reporter at Newsday in New York.)

REINVENTING THE WHEEL



Ask anyone to name the five most significant inventions of humanity, and you can be sure that the wheel will be high on the list. The wheel has its limits, however: it can't move sideways. In some restrictive settings, such as a "flexible" factory floor—in which workpieces have to rotate among robotic manufacturing sites in varying sequences—the simple wheel falls flat.

What is needed is a means of transport that can move sideways, forward, backward, and in a curved path quickly and with great precision. Mark West,

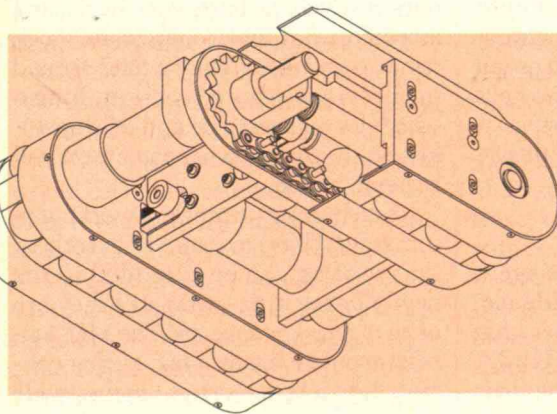
who recently received a master's degree at MIT, has designed such a system under the direction of Haruhiko Asada, a professor of mechanical engineering.

West's "Omnitrak" system consists of two independent sets of parallel drive chains—one on each side of the vehicle—that move like tank treads. Embedded in each set are 12 rubber balls that can circulate in a loop, with 3 to 4 balls in contact with the ground at any time. The balls in each set ride on two rollers that sit inside the loop, parallel to the drive chains.

Four electric motors set the vehicle in motion. To move forward and backward, each set of drive chains—and hence each set of balls—receives power from one of two "forward/backward" motors. Power is transferred through a gear wheel connected to the chains.

Each of the other two motors—the "sideways" motors—transfers power to the balls by a connection with one of the two pairs of rollers. When the motors cause the pairs of rollers to rotate, the balls, which are in firm contact with the rubber-coated rollers, spin perpendicular to the direction of the drive chains, and the vehicle moves sideways.

The vehicle can follow virtually any curved path because its four motors are independent from each other and can run at different speeds. If the two forward/backward motors are operated at different speeds relative to each other, for example, the sets of chains move at correspondingly different speeds, allowing Omnitrak to turn by pivoting like a military tank.



The "Omnitrak" vehicle moves forward and backward by circulating loops of drive chains that are linked to large balls. The device moves sideways by rotating pairs of rollers, inside the loop, that make the balls spin perpendicular to the direction of the drive chains.

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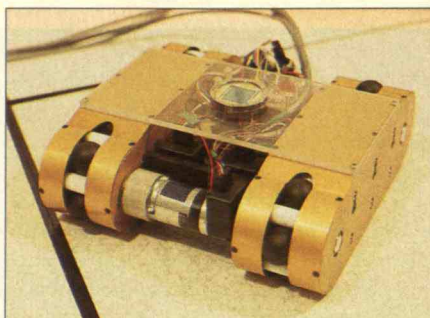
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Two remote-guidance methods have been used to control the vehicle. One technique, which could be used to navigate among manufacturing sites on a factory floor, relies on an on-board computer with a preprogrammed itinerary. The computer counts the number of revolutions each of the four motors makes and then makes appropriate steering adjustments. The other control method, devised by West's colleague Akihira Nishikawa, would enable Omnitrak to position itself precisely at a site. This technique involves mounting at a fixed location, such as on a wall or machine tool, a small laser and beam-controlling mirrors. An electronic system attached to the vehicle detects the beam and responds by controlling the motors.

Omnitrak differs from other "omnidirectional" vehicle designs because its



MIT graduate Mark West has built a desktop model of his omnidirectional vehicle.

driving elements—the balls—move with equal ease and traction in any direction, according to West. Other approaches use wheels that can rotate in only one plane. To move in a particular direction, a motor activates only select wheels, which limits the vehicle's traction. In contrast, the Omnitrak design transfers all available driving power to the six to eight balls in contact with the ground at one time. West says that this allows Omnitrak to accelerate faster and carry a greater load than competing designs of the same weight.

Bulent Sert, vice-president of engineering at Denning Mobile Robotics in Cambridge, Mass., calls Omnitrak a "clever, ingenious design" because it follows complex directions "gracefully." But Sert points out that the mechanism is complicated, requires four motors, and therefore would be expensive to manufacture.

Besides handling materials in a factory, Sert suggests that Omnitrak could transport medical supplies through hospital corridors and move objects in "clean rooms" (where people might contaminate the environment). Omnitrak-type vehicles might also be useful as wheelchairs or, says West, who hails from England, for "driving in Boston."

—LEONARD A. PHILLIPS

friends may therefore wish to withhold the news that there are professors at MIT who hope to tap the enormous volume of unused underground space and make real estate a readily manufactured commodity.

Carl Peterson, associate professor of mechanical engineering and an expert on tunneling technology, points out that underground locations would seem preferable for facilities ranging from electric utilities and railways to waste-treatment plants and chemical factories. "Much has been written about the cost of decommissioning nuclear power plants," he says. "But if those plants had been built underground, they could be decommissioned just by bricking up their front doors."

The costs of underground construction are so high, however, that this option is seldom deemed practical. Peterson, along with Herbert Einstein, professor of civil engineering, and Eric Marsh, a graduate student, recently completed a conceptual design of a tunneler that they hope will lower costs dramatically. The essence of their approach is continuous operation. Contemporary tunneling is plagued by long periods of expensive downtime, in which the borer waits for other aspects of the boring cycle—such as muck removal—to catch up. At least on paper, continuous operation appears to permit lower operating costs.

The continuous tunneling machine coordinates a number of processes whose relative rates vary enormously as the ground at the cutting face changes. A program written by Einstein juggles the rates at which the borer cuts, steers, and moves forward, and it coordinates muck removal and insertion of a liner around the previously bored section. It also schedules maintenance and tells operators on the surface what equipment will be needed when.

Contemporary tunnelers working in soft ground have to pause frequently so that roofing can be extended to the newly bored area—and still they are often plagued by cave-ins. The MIT tunneler would extrude a fast-curing concrete into a space several inches wide

TechnologyReview

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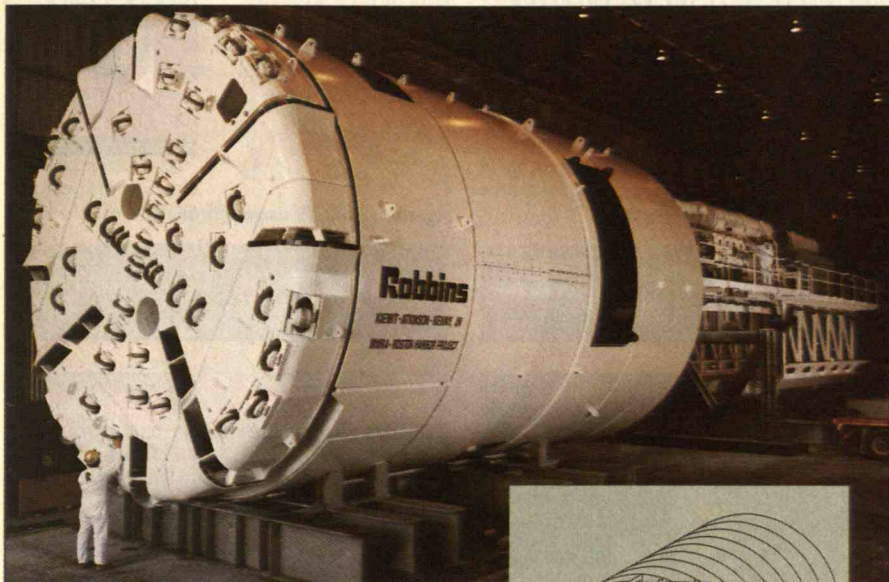
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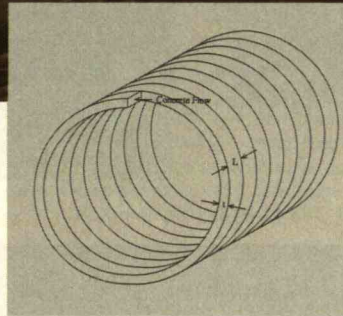
UNDERGROUND ECONOMY



The faith of a real estate agent rests on the happy confidence, shared with every reluctant buyer, that "nobody's making any more land." Readers counting agents among their



While an MIT tunneler design has similarities to current models (above), it aims to lower costs through continuous operation. Instead of pausing while roofing is extended to a bored-out area, the machine extrudes concrete in a spiral without interruption (right).



between the rock wall and a "slip-form"—a metal cylindrical mold that surrounds the machine's main body and moves forward with it. The slipform's length could be adjusted so that by the time the tunneler had advanced, the concrete would be hard enough to bear the weight of the overhead rock.

Traffic tie-ups between the vehicles carrying resources into the tunnel and those carrying rock out are a second source of downtime. The new tunneler would combine these functions with a double-troughed conveyor belt that would bring fresh concrete to the tunnel and remove muck in a single loop. The belt system would be continuously extended from storage magazines that would each hold as much as 2,000 feet of belt ready by running it back and forth in a small space until needed.

The MIT group expects the tunneler to cruise through the earth at an average speed of six meters an hour, adjusting to ground type using information gathered from test bores and seismic exploration.

That rate should be possible, Peterson says, even under difficult ground conditions such as mixed soil and rock, and should be able to lower the cost of tunneling by about one-third. Only some of today's borers can reach this speed under peak conditions.

Eugene Foster, president of UTD, a tunneling company in Newington, Va., says that an average cost cut of even 10 percent would repay the building of a prototype of the MIT design.

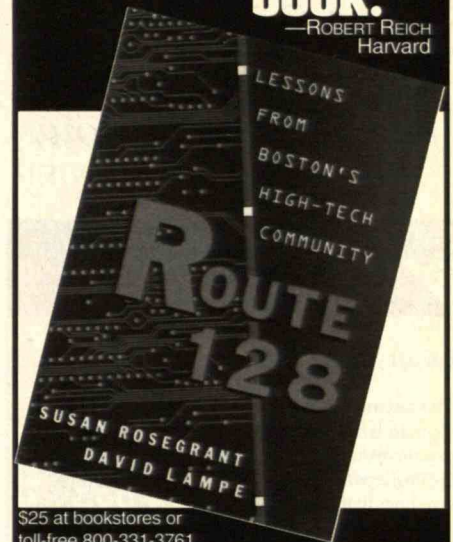
Colin Shellum, a UTD engineer, suggests that such price drops might lead to a surge in underground construction. Above-surface contractors, he says, "face problems of route and grade planning, easement negotiations, demolition and site preparation, community relations, construction noise, interference with utility lines, traffic disruption, security, vandalism, weather damage, pollution control, and long-term liability. All these problems are either ameliorated or absent beneath the surface."

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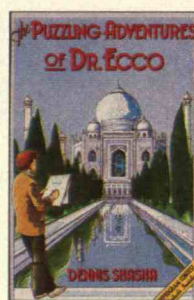


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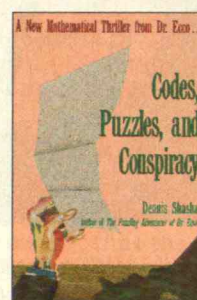
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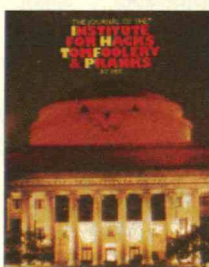
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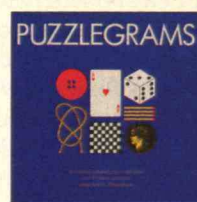


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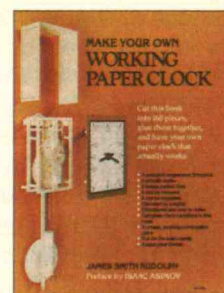


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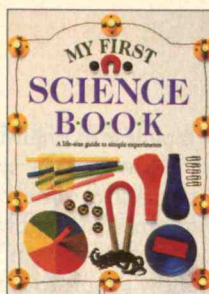


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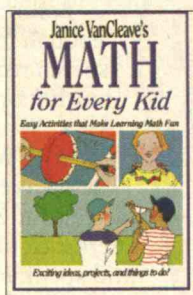


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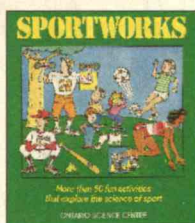


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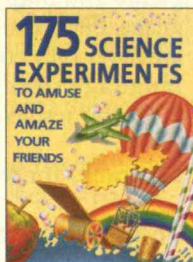


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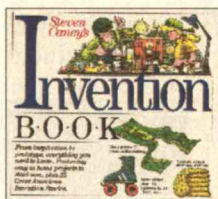


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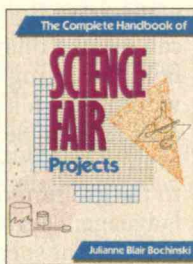


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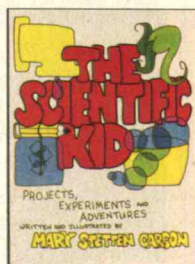


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Trends

Pursuing the Universal Translator

■ "The spirit is willing but the flesh is weak." Translation: "The vodka is good but the meat is rotten." That's the interpretation one Department of Defense computer made in the 1960s, when researchers first began building machines that could translate text from English to Russian. They've come a long way; today, a dozen companies have computer-based translators that can convert 15 typewritten pages of text an hour with greater than 90 percent accuracy in as many as 10 languages.

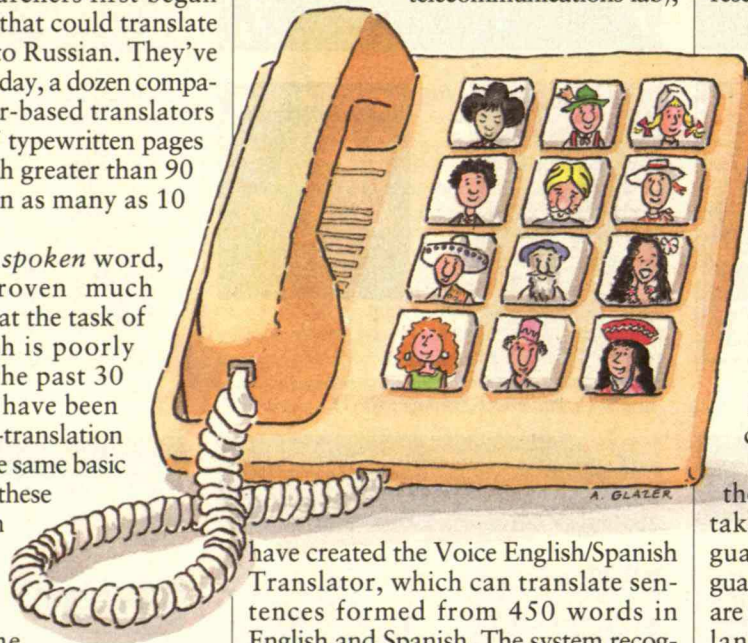
Translating the *spoken* word, however, has proven much tougher. It's not that the task of translating speech is poorly understood. For the past 30 years, researchers have been working on speech-translation systems based on the same basic building blocks. In these systems, a speech recognizer captures the speech of a person talking into a microphone and stores it as digital code in the computer. A sentence parser breaks down each block of code into its constituent parts. A translator converts the pieces into the words of target language and reassembles them in grammatical order. And a speech synthesizer emits the translation in a machinelike voice.

The problem is that translating speech quickly and accurately is so much more complex and time-consuming than text translation—because people speak ungrammatically and their voices sound so different—that the algorithms and accompanying hardware are not yet up to the task.

Still, engineers and linguists have made strides recently thanks to pattern recognition and translation algorithms that are more efficient and robust, digital signal processing chips that can discern a wider range of voices and sounds, and a

host of other system processors and components that are faster, cheaper, and more powerful. In fact, within the past two years, several groups have introduced prototype systems that may find their way into practical applications.

For example, AT&T Bell Laboratories, working with Telefónica Investigación y Desarrollo (Spain's national telecommunications lab),



have created the Voice English/Spanish Translator, which can translate sentences formed from 450 words in English and Spanish. The system recognizes continuous speech, not just isolated words. However, it is speaker-dependent, which means a user must first train it to interpret his or her voice by repeating test words to calibrate the system.

Carnegie Mellon, in conjunction with the University of Karlsruhe in Germany, Siemens A.G. in Munich, and Advanced Telecommunications Research (ATR) in Kyoto, Japan, has unveiled a speaker-independent system called Janus that has a 500-word vocabulary and can translate continuous speech between English, Japanese, and German. The group plans to hold its first three-way telephone conversation (with participants in the United States, Germany, and Japan) this coming January. And last year in Tokyo, NEC Corp. announced its own 500-word, speaker-independent machine that translates

Japanese to English and vice versa.

However, the systems are not terribly versatile. Their vocabularies, for instance, are highly specialized. Carnegie Mellon's system is intended solely to allow people to register for a conference, Bell Labs' system is meant for international banking, and NEC's system is tailored to international hotel and airline reservations. If you asked any of the systems whether it is raining outside, they would stall.

Before translators are robust enough for general applications, speech recognition must become much more flexible, according to Alex Waibel, who runs the Carnegie Mellon translation lab. The speaker-independent systems are about 80-percent accurate if users stick to the limited vocabulary and speak clearly in grammatical sentences. "But if you talk like a real human," Waibel says, "the machines fall apart."

For example, in current machines, the translation software attempts to take the grammar of the spoken language and map it into the target language. But because the rules of grammar are never fully complementary from one language to the next, the mapping inevitably results in errors.

Esperanto for Machines

To address this shortcoming, researchers at Carnegie Mellon, Bell Labs, and NEC are deriving algorithms that translate the spoken language into an independent, intermediate language, or "interlingua," which is a kind of Esperanto for machines. In these interlinguas, every word or concept has only one meaning, which is determined by the context in which it is used. For example, "bank" can mean a financial institution or the land bordering a river; the algorithm would assign a different interlingual code to each meaning. The interlingual forms can then be rearranged according to the grammatical rules of the target language. Because the correct meaning and part of speech can be assigned to

each word, ungrammatical speech can be translated more accurately.

The use of interlinguas, however, places a computational burden on translators; for a given language, the interlingua comprises many codes, which must then be compared to the many codes of the target language. Brute comparisons, like running through the dictionary from A to Z to find the translation for each spoken word, is too slow and hardware-intensive. Researchers are therefore equipping translation programs with neural networks, a class of software that can learn over time which codes correlate and thus quickly narrow the search instead of having to compare the full databases for each new code.

As international business increases, developers envision a growing market for speech-translation systems. To meet the demand, companies have set ambitious goals for developing new products. For instance, Bell Labs plans to build a commercial, speaker-independent telephone translation system by 1995 that can translate from 1,000 to 2,000 words between English, Spanish, French, German, Italian, Russian, Japanese, and Chinese. A caller would dial another country, speak in his or her native language, and be translated for the person on the other end.

Carnegie Mellon expects within five years to produce a pocket-sized electronic translator; a person would speak individual words into a microphone, and the translated words would be synthesized. And the German Federal Ministry for Research and Technology has also just announced Verbmobil, an eight-year, \$80 million effort to develop a portable translator.

But in what is perhaps the most ambitious project to date, NEC hopes to market an automatic, real-time telephone translation system to the major phone companies within 10 years. The system would have a vocabulary of 5,000 to 10,000 words—a sizable portion of human speech, which normally tops out at about 20,000 words.

—MARK FISCHETTI

Designing for Disassembly

Americans are sorting through their kitchen trash, saving empty soda cans, and bundling stacks of old newspaper like never before. Despite all these recycling efforts, we still send 180 million tons of municipal solid waste to landfills each year—4.5 pounds a day for each man, woman, and child in the country.

Now engineers from some of the largest U.S. companies hope to cut landfill contributions further by designing products with the environment in mind right from the start. They are choosing materials that are easier to recycle and combining them in ways that make them easy to disassemble later on.

Though they're just starting to design for disassembly, many U.S. companies say they've been recycling all along. For example, most of the metal components

At BMW's pilot recycling factory in Landsbut, Germany, old BMW models are completely dismantled. Parts that cannot be reconditioned are sorted by material and sold as scrap.



of a car—about 75 percent of the vehicle—are already recycled, mostly by scrap yards and shredders. But that still leaves room for improvement; the other 25 percent of a car (often called “fluff”) consists largely of plastics and foam rubber that are harder to separate. Each year about 3 million tons of fluff ends up in landfills. So last February, General Motors, Chrysler, and Ford formed the Vehicle Recycling Partnership (VRP) to develop ways to recover and reuse as much of the fluff and metal scrap from motor vehicles as possible.

Reusing Plastics

One of the most important facets of design for disassembly is the initial selection of materials that are easy to recycle. For example, of the two basic types of plastics used in cars, thermoplastic and thermoset, only thermoplastics—commonly used as dashboards, consoles, and other interior parts—can be melted down like wax and remolded. Conversely, thermoset plastic—often found in stiff car parts such as exterior panels—is like an egg; it can be cooked only once. Because thermoplastics are so easy to recycle, car makers are now experimenting with ways to use more of them and to substitute them for thermoset plastic when possible. Also, for parts that are best made of thermoset plastic, VRP is experimenting with a process called pyrolysis, which entails burning the material to break it down into oil and gas.

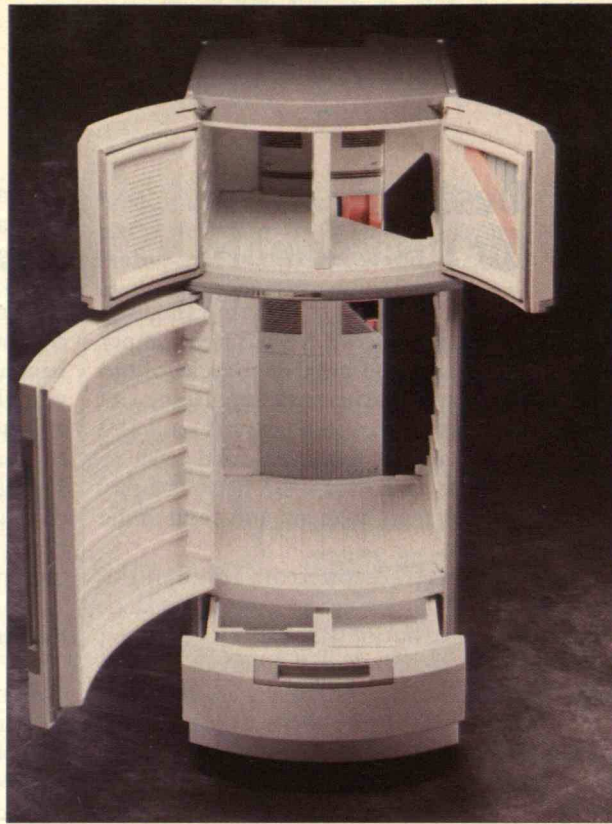
Even once a car has been created from recyclable materials, the battle is not yet won. For instance, individual thermoplastics such as polystyrene, polyvinyl chloride, and polypropylene must be separated, since an impurity could weaken a part, says Jack Dinan, spokesperson for GM's research environmental staff. Thus, many companies are adopting an identification scheme suggested by the Society of Automotive Engineers in which codes are carved directly into the plastic molds. Mack Gray, vice-president of corporate technology and development at Whirlpool,

plans to adopt the codes, which conform to international standards. This will make sorting and recycling much easier, he says, and "15 years from now when recycling is even more important, the value of coded recyclable materials will be dramatically higher" than non-coded materials.

Another important factor in design for disassembly is assembly itself. If parts are welded or glued together, they will be harder to separate—both from each other and from the adhesive compound. Fastening parts with snap fits or screws makes them much easier to take apart. GE Plastics, for example, has created a prototype refrigerator-freezer made of recyclable resins. Normal refrigerators are basically metal boxes lined with plastic and insulated with polyurethane foam. But, at recycling time, it's hard to separate the metal skin from the plastic liner and clean out the foam between the two. Wires and other seals must be removed. And, as a thermoset, the polyurethane is hard to recycle.

GE's fridge of the future, however, is made with thermoplastic foam instead of polyurethane. Its panels are snap-fitted, and all the electrical parts (the temperature control, air distribution, and lighting functions) fit into a single module that can be easily removed for service calls or disassembly. But before the product becomes commercially available, says Roy Watson, manager of advanced design and development at GE Plastics, improvements will have to be made in the thermoplastic foam, which is currently more expensive and less energy-efficient than polyurethane.

The first available recyclable appliance is more modest. Called the UKettle, it's an electric tea kettle made by Boston-based Polymer Solutions from two thermoplastic resins. The reservoir, base, lid, handle, cross brace, and on/off button are made from a modified polyphenylene oxide, which can withstand boiling



Fridge of the future: Unsnapping the outer panels of GE's prototype refrigerator allows easy removal of the unit's recyclable plastic lining and modular electrical components.

water, and the handle and lid grips are made of a copolyester ether. The parts can be easily separated at molded-in break points.

Perhaps the most efficient examples of design for disassembly take place when companies form consortia to pass their used materials along. In one such experiment, Digital Equipment Corp. recycles thermoplastic resin from the housings of old computers that customers have traded in. GE Plastics remanufactures the resin and, working with Nailite Corp., makes it into roof panels. The final panels—made of 52 percent recycled resin—are then installed on the roofs of McDonald's restaurants.

Environmentalists agree that thinking about how to recycle a product while it is still on the drawing board makes sense. But they worry that, so far, U.S. design-for-disassembly efforts may be more talk than action. Robert D. Banks, director of technology and environmental programming at the World

Resource Institute in Washington, D.C., believes that because the United States lacks a mechanism for coordinating efforts in producing environmentally critical technologies, other countries, particularly in Europe, have a huge lead in design for disassembly.

For example, a regulation under consideration in Germany would make automakers responsible for the ultimate disposal of their cars. Adam Opel AG, GM's European subsidiary, is already selling its 1992 Opel Astra in Germany with the guarantee that it will later take the car back for recycling at no charge. GM Europe recently built an experimental disassembly factory and is working with BMW to create

Europe's first full-scale dismantling company. And Ford has built a pilot disassembly plant in Cologne, Germany.

John Young, a researcher at Worldwatch, a Washington, D.C.-based environmental think tank, fears that manufacturers in the United States are unlikely to invest the hefty start-up costs for design-for-disassembly programs in the near future unless a mandate from Congress—a sort of Clean Air Act for recycling—forces them to. In the long run, however, U.S. companies will be forced to keep up with international design-for-disassembly efforts, Young points out, if they want to sell their products overseas.

Economic paybacks closer to home may offer the biggest incentives. "Initially it does cost more to set everything up, but in the long run, you save money," says Joseph Collentro, the former Digital employee who set up the company's recycling consortium and now heads Resources for Environmental Management, a Boston-based consulting firm. He notes, for example, that in one year of recycling cathode ray tubes from used computers, Digital saved more than \$1 million in hazardous waste landfill fees.—DEBRA ROSENBERG

Plotting Revolutions in Electricity Storage

Ever since the principle for the world's first electrochemical battery was documented nearly 200 years ago by Alessandro Volta, the efficient, portable storage of electricity has been an elusive goal. The abundance of batteries on the market today—from alkaline and lithium versions for small consumer electronics to lead-acid products for cars—belies their drawbacks of limited power and longevity that have kept them from finding widespread use in energy-intensive applications like cars, planes, and large-scale electric power storage.

Meanwhile, the concept of a “mechanical battery” that would overcome the limitations of electrochemical technology has been bandied about for years. The idea at the core of the mechanical battery—the flywheel—is as old as the potter's wheel or the grindstone. Revolving wheels store mechanical energy by using their own mass to propel themselves once put in motion. In recent years, flywheels have been used mostly as energy equalizers, such as in car trans-

missions to store the pulsing bursts of energy produced by the engine's pistons.

Engineers have long realized that, at least in theory, flywheels could also be used to store vast quantities of electricity. If a flywheel could be “charged up” to rotate fast enough and kept spinning long enough, it could work like a turbine to pump out electric current over an extended period.

The problem is that centrifugal force rips most materials into shrapnel before they can spin fast enough to generate a significant amount of electricity. And even if a material did hold together, friction in the bearings would slow the flywheels and thus severely limit a battery's shelf life and performance.

Nonetheless, in the 1970s, the mechanical battery idea was deemed promising enough to spawn a government research program—part of the Carter administration's efforts at the now-defunct Energy Research and Development Administration (ERDA) to explore alternative energy sources. The Reagan administration terminated the mechanical battery program, but not before it had proven the technology's potential. George Chang, an aeronautics specialist who headed the ERDA project, says that the team's prototype flywheel batteries worked well when they were tested in a New York subway car and a U.S. Postal Service Jeep, but just weren't efficient enough to be economically viable.

Today, a handful of researchers say they have picked up where Chang and his co-workers left off, exploiting advances in materials and electromagnetic technologies. For example, a recent Seattle-based startup called American Flywheel Systems, Inc. (AFS) is building a prototype mechanical battery based on a flywheel made of a graphite fiber composite. The company claims that its patented mate-



A cutaway view of Lawrence Livermore Lab's flywheel battery shows how the composite-fiber rotor spins on a magnetic bearing (center shaft) while suspended in a vacuum chamber.

rial—with three times the tensile strength of composites available during Chang's research program—is capable of spinning at speeds of 200,000 revolutions per minute, or more than 3,000 rotations per second, without coming apart.

The AFS design, which has only been tested in computer simulations thus far, would float the flywheels in a vacuum upon sets of magnetic bearings that the company says that, depending on the application, could allow them to spin for several months, when not in use. The researchers drew on designs for “frictionless” bearings that date back some 40 years, when a researcher at the University of Virginia set a high-speed rotor spinning on magnetic bearings in a laboratory setting for two years before it ran down.

AFS claims that a pack of ten of its flywheel batteries would fit in a box that would be smaller and lighter than the comparable lead-acid batteries planned for the latest electric car designs, but could take a car 300-600 miles compared to 120 for the chemical battery. Also, while electric vehicles are notoriously sluggish when accelerating, AFS's battery could allegedly accelerate an

An early prototype flywheel battery—developed under the Carter administration's now-defunct alternative energy program—powered a U.S. Postal Service Jeep to a top speed of 40 mph.



average car from 0 to 60 miles per hour in 8 seconds flat, be recharged more quickly, and leave no toxic byproducts at the end of its designed lifetime.

Though AFS is the only corporate entity now built around the mechanical battery, other research groups have been pursuing the concept. For example, a team of researchers headed by physicist Richard Post at Lawrence Livermore Laboratory is also building a prototype flywheel battery. Like AFS, Post's group plans to use composite fiber materials and magnetic bearings. Post plans to test the battery next year as a backup generator to power computers during power outages.

Economic Barriers

Despite promising claims for the technology, some experts are less than optimistic about its chances for success, at least in the near future. "We've seen these sorts of calculations and predictions about flywheel batteries in the past, but it has always proven more difficult to put together a working system," says Philip Symons, manager of stationary energy storage development for transportation at Electric Power Research Institute. And even if a battery can be built, Symons doubts that it can be done so at a reasonable cost. For instance, he notes, "the materials used to make the graphite composites are expensive and difficult to manufacture to the rigid design specifications required to produce perfectly balanced flywheels."

Also, while former ERDA researcher George Chang has "no question about the technical merit" of the latest flywheel designs or about their potential to offer a quantum leap beyond electrochemical batteries, his personal experience leads him to caution that even a successful design cannot overcome other problems of economic inertia and infrastructure. "There's a world of people out there who have made billions from the gas-powered combustion engine," he says. "Why should they want someone else to profit from a new design?"

—SETH SHULMAN

Asteroid Alert

Thomas Gehrels's theory sounds like a combination of *Star Wars* the movie and *Star Wars* the defense technology.

It goes something like this: Thousands of asteroids, some weighing millions of tons, are whizzing about in space. One of these orbiting menaces is eventually destined to crash into earth, ending life as we know it. If scientists can detect the destructive mass in time, they can deflect it with a Herculean assault of lasers and

film over the planet and block the sun. The whole earth would turn to darkness, surface temperatures would fall drastically, and most plant and animal life would die.

Many believe this phenomenon has occurred at least once before. In 1980, the father and son team of Luis and Walter Alvarez at the University of California at Berkeley, studied geographic layers of the earth and found high levels of minerals known to be common in meteors but uncommon to earth. Their hypothesis, that an asteroid or shower



nuclear weapons and save the world.

The trouble, says Gehrels, a planetary scientist at the University of Arizona, is that hardly anyone is taking the threat seriously. Only a handful of astronomers are trying to track the errant asteroids. And no plan exists for dealing with any that might be on a collision course.

The theory that deadly asteroids may smash into the earth is far from science fiction. "It's absolutely feasible to believe it could happen," says David Morrison, chief of the Space Science Division at the NASA Ames Research Center in California. "And it's not overstating the case to say an asteroid impact threatens civilization."

The scenario is that a collision with earth by an asteroid one kilometer or greater in diameter would send a cloud of dust particles into the stratosphere large enough to spread out like a thin

of asteroids was responsible for the extinction of dinosaurs 66 million years ago, is now widely accepted.

According to Richard Binzel, associate professor of earth, atmospheric, and planetary sciences at MIT, some 5,000 objects in space pose a collision threat to earth. Of those, about 2,000 are large enough to wreak global havoc, while the smaller ones might knock out a city or even level an entire country.

Most asteroids are contained in the asteroid belt between Mars and Jupiter. But over the millennia, a number of asteroids began to oscillate in their orbit around the sun because of the countervailing gravitation forces of nearby Jupiter. Some eventually broke free and took off on new orbits that now intersect with that of earth.

At present, only 200 of these objects, or about 5 percent, have been identified

and charted. When Binzel generates a diagram superimposing the orbits of near-earth asteroids over the orbit of the earth for any given month, he finds the number of intersections remarkable. "Then when you look at this diagram and realize the paths charted represent only a small percentage of the near-earth asteroids out there," he says, "the reality sets in that impacts are a natural, inevitable process in planetary evolution."

After a year-long study headed by Morrison, NASA recently urged Con-

When worlds collide: If an errant asteroid larger than one kilometer in diameter crashed into earth, it could send up a dust cloud that would block sunlight and cause most plants and animals to perish.

asteroid detection. His telescope incorporates a chip called a charge-couple device (CCD) to create a computer display of telescopic images 30 times stronger than those visible in existing telescopic photographs, the traditional detection technique.

Gehrels and his two colleagues atop Kitt Peak in Arizona's Sonora Desert use the system to scan the sky on the 18 nights or so each month when bright moonlight does not obscure the view and when the weather permits. Because of their size and distance, the location of stars and galaxies remain stationary between observations, but the relatively dim asteroids, traveling as fast as 50,000 miles an hour, are readily apparent on the computer display.

Unfortunately, the telescope can monitor only an 8 degree angle of the sky at a time, and in a each month it can cover only a fraction of the sky. Gehrels hopes to build a more advanced telescope that would view a wider arc. Besides applying for possible Space Guard funds, he has received funding from various scientific grant proposals and from private donations, but has so far been able to raise only half of the \$1 million dollars he believes is required.

Jurgen Rahe, planetary scientist at NASA headquarters in Washington, D.C., says that most of the scientists seeking to participate in Space Guard wish to enlarge their telescopes or add CCDs, and most request sums similar to that sought by Gehrels. Rahe estimates, however, that NASA funding for detecting near-earth asteroids for the 1993 fiscal year will only be "somewhere in the hundreds of thousands of dollars."

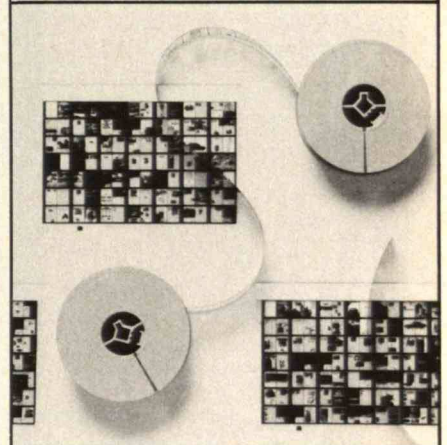
Assuming that adequate deflection systems get built, what would we do if an oncoming asteroid were detected? Most analysts would favor using some sort of nuclear device to deliver an "impulse" to make the asteroid veer from its path. Blowing it up, the other option, would simply create an asteroid shower and cause similar devastating effects, says Binzel. "It would be like getting hit by a lot of buckshot rather than a single cannonball."—MUBARAK S. DAHIR

gress to spearhead an international effort, dubbed "Space Guard," to set up a worldwide network of six telescopes dedicated to discovering and tracing near-earth objects. Two of the telescopes would be located in the United States, with the others in Russia, India, Australia, and France. Morrison estimates the network would cost \$50 million to build and \$10 million a year to operate, for the 20 to 25 years he estimates would be required to track the remaining near-earth objects and determine if and when a collision might occur.

In Search of Funding

More than 50 scientists have applied for funds to upgrade their telescopes to participate in the Space Guard program. One of them is Gehrels, whose current system is already near state-of-the-art for

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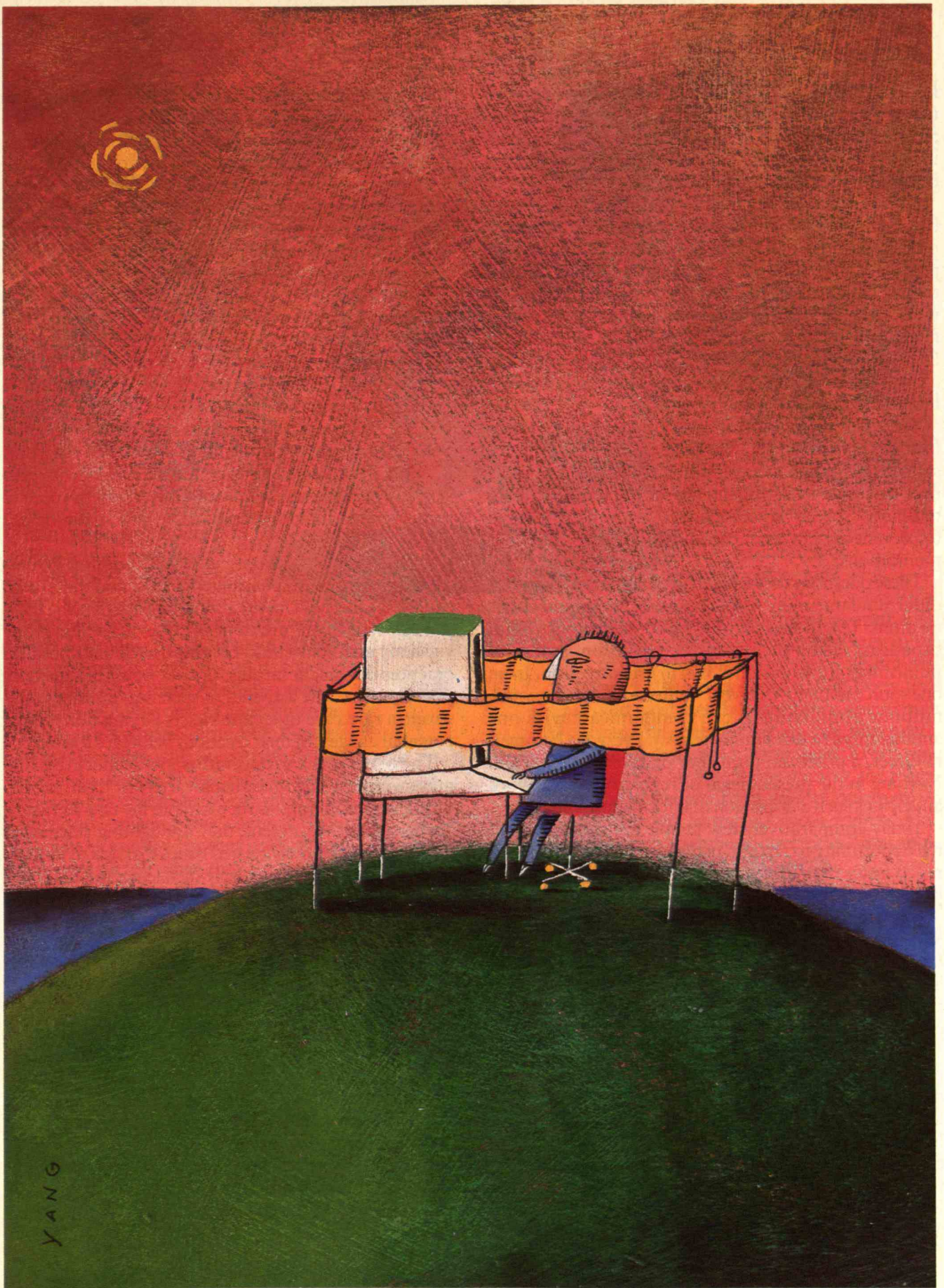
BY HERB BRODY



DO CONSTITUTIONAL RIGHTS TO FREEDOM OF EXPRESSION
AND PRIVACY EXTEND INTO THE TERRITORY OF ELECTRONIC
COMMUNICATIONS? WE'D BETTER DECIDE SOON—BEFORE
THE SETTLERS ARRIVE IN HORDES.

INHABITANTS of our angst-ridden urban society often yearn for the close community of long-ago village life—where, to quote the popular TV theme song, “everybody knows your name.” Technology is making this return possible, at least figuratively: the ability to commune with “neighbors” around the world through a computer keyboard and a telephone line has created something new—a small town, globally distributed. But there’s a dark side to this folksy metaphor. Ask people who have lived in small towns and they’ll tell you that what you gain in friendliness you lose in privacy. Mabel the phone operator

ILLUSTRATIONS: JAMES YANG



YANG

knows your business, and sees nothing wrong with telling it to Floyd the barber and Andy the sheriff. There aren't many secrets in a village, and freedom of speech usually ranks second, after the imperative to avoid offending other community members.

Computers and electronic communications, with their seductive power to store and manipulate enormous quantities of information, are raising threats to privacy that go far beyond the benign meddling of small towns. Computers linked to telecommunications networks spread information—and misinformation—faster than it can be managed. As access increases, so does the potential for loss of privacy. While an outcast of a small town can always leave, few can escape the ever-more-ubiquitous computer network.

The emerging network is also raising questions about freedom of expression. Who can be held responsible for statements posted on a computer bulletin board? What right do the government and private organizations have to censor "speech" disseminated over the network, and to prevent citizens from encoding their electronic communications?

These questions defy easy answers because computers differ fundamentally from any other communications medium. Telephones permit one-to-one contact. With broadcast media such as radio, television, and print publishing, information flows in one direction, from one source to many receivers. With computer networks, millions of individuals can communicate with one another more or less simultaneously. Everyone becomes, in effect, a potential publisher or television station. Nothing in the present legal or regulatory framework anticipates such a dispersion of information sources.

Today comparatively few people take advantage of the opportunity to tap into networks, but use is growing much faster than any consensus on rules for governing privacy and free expression. As of 1991, there were almost 60 million personal computers in the United States, and a PC could be found in 26 percent of households. Many of these computer users exchange ideas and trade software on local computer bulletin-boards, thousands of which are linked in a national system called FidoNet.

And somewhere between 5 and 10 million people now communicate on the Internet—a huge "mother network" that originally served government and academia. The number of computers connected to the Internet has been doubling every 8 to 15 months for the past three years, says Vint Cerf, vice-president of the Corporation for National Research Initiatives in Reston, Va., which writes standards for the network. These proliferating networks are transforming the per-

sonal computer into soapboxes on which millions can stand to blare their message to the world.

Moreover, the telephone system is shifting to all-digital transmission, which would make computer communications work more smoothly. And recent court rulings allow telephone companies to offer information services, which the terms of the Bell System divestiture had originally forbidden. The pieces are falling into place for a national public computer network.

While the network is taking shape, concerned groups and individuals are working to ensure that privacy and freedom of expression do not get short shrift. One of the most outspoken defenders of such rights is the Cambridge, Mass.-based Electronic Frontier Foundation. Headed by Lotus Development Corp. founder Mitchell Kapor, EFF aggressively supports rapid implementation of a national network available at low cost to everyone. Mindful of the inherent risks, Kapor speaks with passion and great technological authority about the need to preserve individual freedom in the new realm he has helped to create.

Other advocacy groups, such as Computer Professionals for Social Responsibility (CPSR) and the American Civil Liberties Union, also anticipate that the technology will bring much good. Nevertheless, they vigilantly attempt to head off governmental or business practices that might infringe privacy or curtail freedom of expression. The activities of such organizations constitute a rare case of technologists paying heed to the potential dangers of their creations before it's too late.

These network aficionados are something like minesweepers, encountering a variety of legal, regulatory, and ethical traps as they explore the new terrain of "cyberspace." At present, they are fighting skirmishes on a number of loosely related issues that, taken individually, do not seem particularly menacing and that have barely appeared as blips on the radars of Congress and executive-branch policymakers. But the outcome of these fights could profoundly influence patterns of communication for a long time to come.

Looking for a Model

The novelty of the emerging universe of computer networks makes for confusing First Amendment status. Is a posting on an electronic bulletin board equivalent to making a speech in a town square, publishing a newspaper, or talking to someone on the telephone? In practice, the communities that have sprung up around electronic watering holes are making up the rules of conduct as they go along. In some cases this results in censorship. Prodigy Information Service, for example—a joint venture of Sears and IBM that aspires to be a kind of national electronic gathering place—has shifted policies several times regarding what kind of messages it will

allow to be posted. Using software to scan each message, Prodigy looks for obscenities and other words that indicate possible offensive content. Any message that the program flags is routed to a Prodigy editor for inspection. Unsuitable postings are suppressed and the writer is sent a standard rejection note.

But must everything on-line meet such Disneyesque standards? "It would be horrible if you couldn't use this medium unless you don't offend anyone," says Alan Westin, professor of public law and government at Columbia University. Westin proposes labeling computer bulletin boards much as movies are rated. Prodigy could maintain its standards as a family medium and receive the equivalent of a G rating. Sexually oriented material—which exists in abundance on computer networks—could be X-rated and passwords to gain access issued only with proof of age. These systems would notify users when they sign on of the nature of the material they contain. "People ought to know what they are opening themselves up to" when they log on, says Westin.

However, a recent federal court ruling in New York suggests that this strategy may be counterproductive. CompuServe Information Service was sued for libel because of information disseminated in an on-line newsletter. The judge ruled that CompuServe could not be held responsible because it was not like a newspaper, resembling instead a bookstore or library. A newspaper publisher is responsible for libelous statements, but a bookstore owner is not, because it is unreasonable to expect the owner to review the contents of all books sold.

This decision means that operators of bulletin board systems ("sysops," as they're known) can shield themselves from liability by practicing laissez-



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faire—letting anything and everything go on-line. Any service that adopts a more restrictive approach by, say, prohibiting obscenity or racial insults, begins to resemble a newspaper and can thus be held legally accountable. Prodigy vice president and general counsel George Perry suggests that bulletin boards issue a disclaimer each time users log on—a statement saying, in effect, that they can read posted messages at their own risk.

A Question of Expectations

Unlike First Amendment proponents, those battling to preserve privacy in the new world of widespread computer networks may be doomed to fail. Every time you pay taxes, buy insurance, use a credit card, or apply for a loan, you surrender a bit of personal information. Every time you call an 800 phone number, the recipient gets a record of your phone number, which can be traced to your address using the "reverse phone directories" that some telephone companies market.

Both governments and businesses have amassed huge databases. Much of the information can be cross-referenced and aggregated using an individual's Social Security number, which has become (in direct opposition to the original intent) a national identification number. It's possible, knowing only a few pieces of information about individual people, to assemble dossiers on where they live, what they buy, and who they associate with. "Privacy is already shot to hell and there's not a chance to retrieve it," asserts Jim Warren, a computer industry conference organizer and author based in Woodside, Calif.

But Marc Rotenberg, director of Computer Professionals for Social Responsibility's Washington office, says networks should offer users the same degree of con-

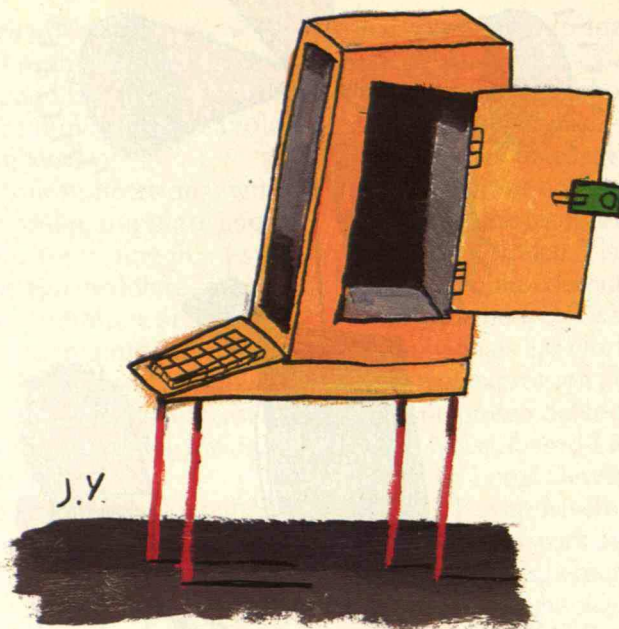
fidentiality they have come to expect from a visit to the town library. A library permits patrons to check out books free of charge with no questions asked. A person can browse through the stacks of a library without leaving any record; anyone could spend hours perusing material on virtually any subject and no one would be the wiser for it. The librarians won't tell.

In effect, this approach would treat the network as a common carrier, like the postal service and the phone company. A common carrier traditionally places no restrictions on the content of the traffic it carries, nor does it take any legal responsibility for it (you can't sue the phone company for slanderous phone calls that pass through its lines).

But Warren challenges the view that privacy should be paramount to other values: if we want large amounts of information easily accessible to large numbers of people, we have to recognize that it will be impossible to keep our lives secret. "You give up some privacy every time you join a community," he says.

Civil libertarians reject such fatalism not just on general principles but for a strategic reason: the Supreme Court has held that when there is a "reasonable expectation" of privacy, then privacy should be enforced. The court ruled that even the user of a public pay phone can reasonably expect protection from eavesdropping. But can society expect this protection to follow into the realm of computer networks?

Electronic communication is inherently more vulnerable to interception than conventional forms of communication. Phone calls can be tapped one at a time, but the tapper must listen to the whole conversation. Paper mail can be intercepted, but it is laborious to search large quantities. By contrast, every e-mail message or bulletin-



THE SUPREME
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board posting is stored on a central computer so that it can be forwarded to its recipient or broadcast to all network subscribers. Once stored, electronic messages can be searched for certain words, phrases, or names. Surveillance takes on an ominous new dimension.

Is it reasonable for a computer user to expect, much less demand, the same privacy protections afforded paper mail and telephone calls? Users hope the answer is yes. A kind of community consciousness-raising is now occurring through the silent cacophony of on-line discussions. If net-

work users establish among themselves an expectation of privacy, they are laying the foundation for legal protection.

But this strategy might not work quite as planned, says Janlori Goldman, director of the American Civil Liberties Union's technology and privacy project. The courts have defined "expectation of privacy" to reflect not so much a collective mindset as a technological possibility, she maintains. Thus as long as electronic communications are technically easy to snoop on and computer users know this, then the courts could rule that a reasonable person cannot expect absolute privacy.

A Tappable Network?

Ironically, digital technology offers, in principle, unprecedented privacy. It is possible to use a computer program to encode a message so that its meaning will be revealed only to someone possessing a digital key. Such "encryption" serves two principal purposes: it ensures that only the person for whom the message is intended will read it, and it guarantees that the person who appears to have sent a message is indeed the actual sender. Without encryption, someone skilled in software manipulation can with relative ease impersonate

someone else over the network. (Although virtually all systems require users to enter a password, hackers can run programs that quickly try dozens of likely passwords.)

Right now, anyone in the United States can legally encrypt an electronic message. This is a relatively tolerant policy; France, by contrast, permits encryption only for government-related communication. Several U.S. software companies license the most advanced and commonly used encryption algorithm, patented by RSA Data Security of Redwood City, Calif.

Still, few commercial products have built-in encryption capability. The reason is that the United States forbids export of any product containing the RSA algorithm, and software companies are reluctant to develop programs they cannot sell abroad. (Ironically, the U.S. government does not restrict cryptography imports. Thus a U.S. company wishing to sell cryptography products in the United States would do best to move operations overseas.)

The result, say cryptography advocates, is that most electronic communications have all the privacy of a postcard. This may suffice for the casual exchanges that comprise much electronic-mail traffic. But unless users can be assured of higher security, computer networks will languish. Not many items of paper mail really require secrecy, yet few people would accept a system that in effect forced every letter to be sent in an unsealed envelope.

Meanwhile, the law-enforcement community, seeing computer networks as the latest venue for criminals to conspire, may soon attempt to restrict domestic encryption directly. The Federal Bureau of Investigation has proposed legislation that would require all the switching computers in both the public telecommunications network and private organizations to be "tappable." The bill, which the FBI hopes to put before Congress this fall, attaches a stiff penalty—\$10,000 a day—for any company failing to comply. The bill does not specifically mention encryption, but if law-enforcement agencies consider wiretapping an entitlement, then banning technology that significantly raises the difficulty of conducting surveillance would seem to make sense, says CPSP's Rotenberg.

The proposal reflects the FBI's concern that the new digital network will stymie attempts to conduct court-sanctioned surveillance. Old-fashioned telephone lines can be tapped with relative ease, says James K. Kallstrom, the FBI's chief of investigative technology, since each voice conversation travels along its own wire loop. Digital technology, in contrast, interleaves hundreds or even thousands of conversations and data transmissions on each wire or optical fiber. Manufacturers of switching computers have not built into their products a way to extract the contents of a particular line, claims Kall-

strom. The proposed bill would require that all phone equipment have such capacity.

Although Kallstrom says that members of the law-enforcement community "only want to keep the same access we already have," the FBI's proposal has raised a fury among civil libertarians. "Wiretapping is a necessary evil, but to treat it as an entitlement would be a great mistake," says Rotenberg. Columbia's Westin concurs: "It's like saying that no private home may have thick steel doors because some day the police might want to kick the door in as part of a lawful criminal investigation."

These opponents contend that the FBI is indeed seeking new authority. Rotenberg draws an analogy from outside of cyberspace: a hotel manager must open the door of a room for police only if they have a search warrant, and similar requirements currently exist for wiretapping. "What the FBI now wants," Rotenberg says, "is akin to requiring a hotel manager to leave a master key with the police so they will be able to search any room at any time." He points to the bill's stipulation that phone switching systems allow the FBI to record calls from a "remote facility"—that is, without having to go to the premises of the person whose line is being tapped or to a central switching office. This provision implies that FBI agents could sit at a terminal, punch in an authorization code, and tap any line they choose, Rotenberg maintains.

Nothing in the bill would change the legal status of wiretapping—police would still have to get a warrant if they wanted to use in court any evidence obtained from a tap. But that ignores the way police actually operate, says Kenneth Phillips, professor of telecommunications at New York University and chair of the Committee of Corporate Telecommunications Users, a nonprofit lobbying organization. Often police will tap a phone line simply to gather background information that can help persuade a judge to issue a warrant, he maintains.

Besides, critics note, the FBI ought to figure out its own ways of conducting wiretaps. "Historically," says EFF staff counsel Michael Godwin, "when advances in communications technology have raised problems for law enforcement, the government has coped by developing advances in its own investigative techniques. When telephone systems made it hard to monitor suspects' plans and activities, the government didn't outlaw telephones—it learned how to implement wiretaps."

But the FBI objects to the notion that it should have to continually play catch-up to the criminal community. "That doesn't seem to me a very good use of resources," says Kallstrom. "Why should we spend millions of taxpayer dollars to develop systems to conduct legally authorized wiretaps? Wouldn't it be a lot more efficient to cooperate in the beginning?" He cites cellular telephones as an example of what can go wrong. The only

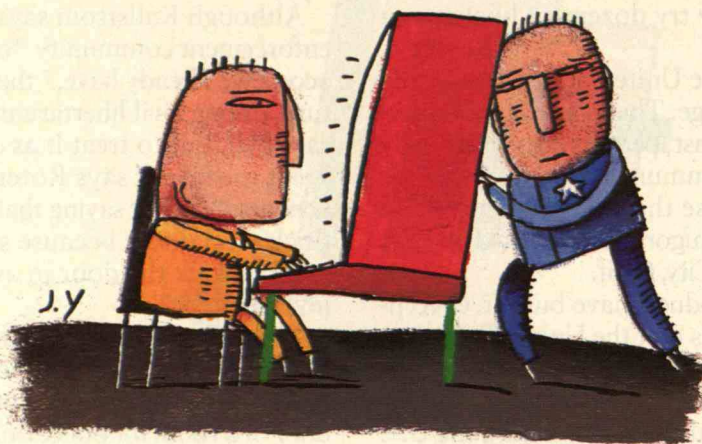
way to tap a cellular call is to plug into one of about five ports in the cellular switch. In lower Manhattan, he says, there are typically "100 court-ordered wiretaps vying for these five ports. Criminals understand this and use cellular communications with impunity." Kallstrom insists that allowing the entire phone network to evolve into such a haven would be disastrous for law enforcement.

The FBI proposal marks an opening salvo in what could become a protracted battle between government agencies and civil-liberties advocates. But even those allied with the law-enforcement community admit that public demand will eventually bring encryption into widespread use, says Donn Parker of SRI International in Menlo Park, Calif. The question then becomes how to catch the bad guys without tapping their phone calls. Ironically, the answer may be to permit police greater physical access to suspects' houses and offices, where surveillance can be imposed before information is encrypted.

For instance, Parker proposes that cameras could be positioned to take video images of hands on a computer keyboard. Investigators could then play back the tape frame-by-frame if necessary to reconstruct what was entered into the computer. Conversations could be monitored by bouncing a laser beam off the window; voices cause the window to vibrate, and the vibration modulates the reflected beam. But such measures seem even more intrusive and Orwellian than old-fashioned wiretapping.

A Delicate Balance

Overall, the flares of conflict beginning to dot the cyberspace are shedding more heat than light. The rhetoric of the EFF and CPSR exaggerates the desire of government and business to wantonly snoop on



the computer-using citizenry and chill their right to speak freely. Likewise, the law-enforcement community's reply to bulletin board operators who object to raids on their systems—if you didn't do anything wrong, you don't have anything to worry about—is equally unconvincing.

But if civil libertarians overstate the immediate danger, they are accurately portraying the long-term threat. Society needs to protect computer use, says EFF's Godwin, because history shows

that whatever rights are not explicitly protected will probably be infringed. As evidence, he cites the government's raids on computer bulletin boards thought to be involved in illegal activity. Federal agents in these raids have not simply copied material from the disks but confiscated computers in what EFF claims is a violation of the Fourth Amendment prohibition against unreasonable search and seizure.

Partly in response to such fears, Harvard law scholar Laurence Tribe suggests that the Constitution itself be extended to explicitly cover cyberspace. He proposes a Twenty-Seventh Amendment to ensure that protections of free speech and against unreasonable searches apply regardless of the technological medium used to transmit, store, or alter information. (In 1967, the Supreme Court similarly extended Fourth Amendment protections to telephone conversations.) The proposal has yet to be introduced in Congress.

If amending the Constitution seems to be everybody's favorite blunt policy instrument, less grandiose proposals are more likely to move beyond the conceptual stage. NYU professor Phillips, for example, says that Congress should convene a commission of experts "to study these issues in depth." But no blue-ribbon report is likely to spur Congress to quick action. One reason is that it is unclear who in Congress "owns" the issue. In the Senate, for example, questions on how to

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establish a national information infrastructure are handled by the Science, Technology, and Space Subcommittee. Privacy issues, in contrast, are in the domain of the Judiciary Committee, which is not strong in technical expertise. Such balkanization slows progress.

One way to accelerate change, some believe, would be to create a watchdog organization—a “data protection board” with members appointed by the president subject to Congressional approval—to identify actions by business and government that threaten privacy. Such a board might, for example, have alerted the public to Lotus’s plans to market a database containing the names, addresses, and buying preferences of millions of Americans. A few activists, working in the populist medium of computer networks, raised such a furor that Lotus abandoned the product after spending millions to develop it. But there was nothing inevitable about that outcome. A data protection board would serve as a kind of ombudsman, giving citizens a stronger voice in protesting questionable practices as well as advising businesses on how to steer clear of privacy abuses.

The United States might look abroad for guidance. Ever since the terrors of Hitler’s occupation, when the Nazis used telephone records to identify suspicious individuals, Western European governments have enforced

strict privacy regulations. It is illegal, for example, for European phone companies to keep any record of who citizens call, aside from the limited information needed for billing.

Canada, Britain, Australia, and other countries have already created privacy protection organizations that have considerable power. In Germany during the early 1980s, for example, privacy advocates forced the government to postpone a planned census that the critics said was too intrusive.

Meanwhile, there is reason for optimism in the United States; civil libertarians are joining with technologists as the network grows from infancy. And computer users are, in fact, a particularly powerful elite, assuming that the country’s economic future belongs to information-savvy people.

Still, policymakers should not be distracted by a misguided focus on the elites: a universally accessible computer network that citizens may contribute to freely, without fear of surveillance or censorship, will be good for everyone. Ultimately, computer users are hoping to create far-flung communities that combine the friendliness of a pastoral village with the sophistication, tolerance, and opportunity for growth and new experience offered by life in a modern city. ■

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*Forging a revolutionary new partnership
between labor and management is key to reviving American industry.*

Workers (and Managers) of the World Unite

BY BARRY BLUESTONE AND IRVING BLUESTONE

LIFE in the American workplace is changing. Industries are caught up in a whirlwind of experiments with “employee involvement,” “problem-solving teams,” “autonomous work groups,” and “participative management.” Along the way, “worker empowerment” has become part of the lexicon of some of America’s toughest CEOs. Company leaders are ordering line supervisors to show greater respect for employees who not so long ago were treated merely as expendable cogs in a vast production machine.

Teamwork, cooperation, and mutual trust are in; adversarialism is out.

These are refreshing trends. And companies heeding the call for a dose of economic democracy have significantly improved their performance and competitive posture. But the transformation of U.S. business is not spreading anywhere near fast enough or penetrating deep enough to meet the doggedly persistent challenge of global competition. Too few companies have taken industrial relations much beyond the archaic model of boss as "order giver" and employee as "order taker." And when times get tough, even the most progressive firms respond by getting lean and mean—that is, they lay off their workers.

An American economic renaissance requires not merely improvement but a revolution in the nation's work culture and in the structure of labor-management relations. Instead of limiting workers' input to the factory floor or outer office, management must bring labor into the inner circle where strategic decisions about the enterprise are made. And instead of viewing the company as its mortal enemy, labor must be willing to focus its energy on improving the competitiveness of the enterprise.

End of the Glory Days

The pressure for a labor-management revolution is of recent vintage. During America's economic "glory days"—roughly from 1947 through 1973—conflicts in authoritarian workplaces did not prevent stockholders from enjoying buoyant profits and workers from enjoying a modicum of employment security and a steadily rising standard of living. If workers stood around while engineers and supervisors tried to solve a machining problem because line employees were not expected to solve it on their own, or even allowed to try, there was enough slack in the system to permit such inefficiency. Hardly anyone was losing sales or jobs to the Japanese or the Germans, let alone the South Koreans or the Taiwanese.

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But by the mid-1970s, the effortless economic superiority that America had come to know in the aftermath of World War II—measured in terms of productivity, product quality, and product innovation—evaporated in one industry after another. Productivity growth in the 1970s and 1980s fell well below previous post-war levels and continues to trail the growth rates achieved by our trading partners. With wages and profits outstripping efficiency growth during the 1970s, U.S. production costs increased relative to the competition with the result that many American goods were priced out of the market.

Product quality also lagged. By the mid 1980s, Americans were buying Hondas instead of Chevys not because they were cheaper—in fact they were not—but because their performance was better, their fuel efficiency superior, and their frequency of repair lower.

And in terms of new-product development and innovation, American firms were falling rapidly behind. VCRs and Nintendo games have perennially dominated Christmas sales, yet not a single one is designed or built by a U.S. firm. We can now add the laptop computer, the fax machine, and the video camcorder to the list of products for which the U.S. market share is essentially zero.

Why, after so much success in the early post-war years, has the United States fallen behind in these areas? The best economic statisticians have been able to explain only a fraction of the sharp decline. The oft-mentioned culprits of unsatisfactory savings rates and anemic capital investment, the shift from manufacturing to services, rising energy prices, and government "over-regulation" are apparently responsible for much less than half of the loss. After dozens of attempts, the consensus is that the remainder of the decline is due to "unmeasured factors."

But what is unmeasured? An intriguing factor, by economists' reckoning, is the failure of corporate managers to manage resources effectively. That productivity growth has been lowest in the labor-intensive service sector—indeed, negative in some nonmanufacturing industries including finance, insurance, real estate, and construction—suggests that how labor is used in the firm may well be a dominant reason for the collapse in U.S. productivity growth.

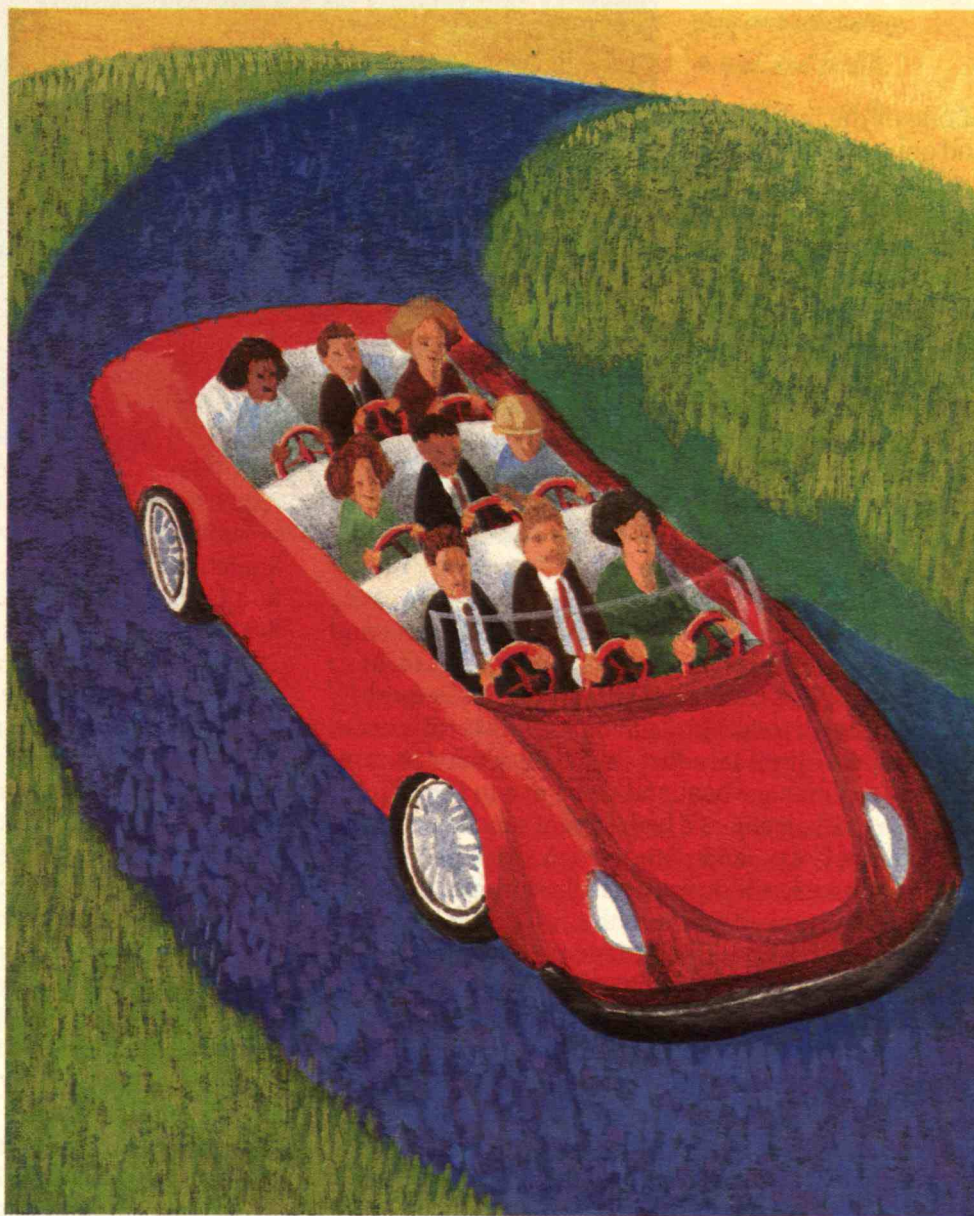
One revealing bit of data can be found in a major study of corporate efficiency conducted during the late 1970s by Theodore H. Barry Associates, a management consulting firm. The study found that only 4.4 hours of

a typical employee's work day are used productively; some 1.2 hours are lost because of personal and other unavoidable delays while 2.4 hours are "just wasted." Such inefficiency is not anywhere near as common in Europe and Japan. This research does not necessarily imply that labor is lazy in America; it suggests that workers are poorly managed, that their intelligence, skill, and motivation go underused.

Employee Empowerment

As international competition began to squeeze profits, firms concluded correctly that they needed to get more than 4.4 hours of work out of an 8-hour day. To their discredit, however, and for many firms their demise, corporate leaders often went about improving efficiency in precisely the wrong way. They rolled up their sleeves, took a deep breath, and proceeded to imitate a management style pioneered by the Prussian military.

Because of its now infamous CEO, the most publicized case is Eastern Airlines. Aaron Bernstein, a journalist who followed the airline during its turbulent flight to bankruptcy, writes that Frank Lorenzo "represented the get-tough approach to management that Ronald Reagan had revived when the president fired striking air-traffic controllers in 1981." Instead of maintaining the high level of labor-management cooperation that had been forged in the company before his arrival, Lorenzo swerved 180 degrees. Intimidating employees into working harder and enacting unprecedented wage and benefit cuts, he so alienated them that they were ultimately willing to sacrifice their jobs to get rid of him. In fact, in April 1990, in the wake



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of one of the most bitter strikes in recent U.S. history and only four years after Lorenzo took over Eastern and the management of its 38,000 employees, a New York bankruptcy court declared him unfit to run the company. Eastern's logo disappeared from the sky and all employees lost their jobs.

Fortunately, a growing number of companies are much closer to the opposite end of the labor-management continuum. In their 1984 nationwide compendium *The 100 Best Companies to Work for in America*, Robert Levering and his colleagues identified the "best" companies as those that had transcended the manipulative framework of traditional management and achieved a sense of "we are all in it together." According to their criteria, a "good" company makes people feel that they are part of a team or, in some cases, a family. It encourages open communication, informing people of new developments, and encouraging them to offer suggestions and complaints. It stresses quality, enabling people to feel pride in the products or services they are providing. It reduces the distinctions of rank between top management and those in entry-level jobs. And, as a result, it enjoys a high level of success.

Donnelly Corp., a Holland, Mich.-based manufacturer of mirrors, windows, and glass products for the auto industry, ranked as one of the 100 best. The goal at Donnelly is worker self-management. The firm has removed time clocks from its factory floor and put everyone on salary. Employees work in teams of eight or nine, with each team responsible for its own production goals. No one can be displaced by technological improvement. All grievances are reviewed and employee policies set by a plant-wide committee with two-thirds of the membership composed of production workers. And all Donnelly employees share in profits through a bonus system.

Between 1975 and 1984, productivity at Donnelly rose 110 percent—a compounded rate of better than 7 percent per year, or five times greater than the national average. Despite the grave recession that struck the auto industry in the early 1990s, the company continued to expand and remain profitable. Employment has more than doubled since 1985, partially as a result of successfully increasing sales volume to the 10 major Japanese auto plants operating in the United States. The company openly credits its success to employee empowerment.

Dozens of other firms and organizations have reaped similar rewards from greater worker participation. At Corning Glass, for example, management and the union

jointly established teams of hourly employees to redesign their factories and decide who should work which jobs. A total of forty-seven job classifications were folded into one. Employees rotate through jobs and earn higher pay for each new skill they learn in a "pay-for knowledge" system.

Those who have studied the Corning Glass case conclude that the company's improved labor-management relations contributed significantly to improved quality and profitability. Since the program was implemented in 1983, defects in the ceramics plant have been cut from 10,000 parts per million to 3 parts per million. And return on equity rose from 7.3 percent to 16.3 percent.

Such union-management team efforts have not been limited to the private sector. The New York City Sanitation Department's Bureau of Motor Equipment (BME) has made extensive use of joint action. Working with the 20 trade unions representing the facility's repair workers, the deputy commissioner of BME began establishing joint problem-solving teams throughout the facility in the late 1970s. As a result, vehicle downtime declined markedly, work that was being assigned to private contractors was brought back in-house, and skilled workers were hired to staff a preventive-maintenance unit. One of the teams was even credited with designing a robot for repainting sanitation equipment. In the first year of service operation, the work teams increased productivity by 24 percent and saved the city \$2.4 million.

A Critical Element: Unions

A recent study by William Seidman, the former chairman of the Federal Deposit Insurance Corp., and his colleague Steven Skanche found one thing in common among U.S. companies that maintained their competitive edge: virtually all had implemented substantial labor-management innovations aimed at empowering workers. Other researchers have found two additional factors that substantially increase the odds of success. One is a system of financial reward for employees through profit or gain sharing. When workers as a group share the rewards of improved productivity, quality, or company profitability, their motivation pays off more handsomely.

Study after study shows that the other factor contributing to higher productivity and quality is the presence of a labor union. Participation turns out to work best when it is organized jointly between union and management and when workers have a voice indepen-



Self-directed teams of employees at Corning Glass are responsible for their own scheduling, output, and quality assurance. Since the company's worker-empowerment program began, defects have dropped from 10,000 to 3 parts per million, and return on equity has jumped from 7.3 to 16.3 percent.

dent from management that cannot be unilaterally stifled. Mixing adversarial and cooperative relations—negotiated within a context where employees are represented by legally recognized unions—proves to be the most successful form of employee involvement for all participants.

Suggesting that unions might be a critical missing element in a national campaign for global competitiveness may seem far-fetched. In some circles, deep resentment of unions remains. Union leaders have traditionally received ratings in opinion polls right down there with politicians and used-car dealers. As late as 1981 only half of Americans had a favorable view of labor leaders and fully two out of five Americans viewed them with hostility.

In some cases, unions have brought this on themselves. In the incessant struggle to maintain job security for members, unions face enormous pressure to retain outdated work rules. The most flagrant examples receive great attention: after the diesel locomotive replaced the steam-driven railroad engine, the engineers' union insisted on maintaining a fireman on board to stoke a non-existent coal-burning furnace. In other situations, electricians have refused to change light bulbs because that task was not explicitly written into the job description. And at the start of the school year in the fall of 1991, the school bus drivers in Boston exasperated parents and school board members by striking for the third time in six years in a bid to gain another pay raise—at a time when teachers were being laid off.

Although this type of behavior demeans the union movement, the instances in which unions cross the boundary of unjustified behavior are relatively isolated.

In fact, more than 99 percent of all contract negotiations between companies and unions are concluded without a work stoppage. Most unions today recognize the fact that if the companies they bargain with are not profitable, their members' job security will be severely jeopardized.

But even more important, there are good reasons for the widespread findings of positive effects of unions. One is that unionized employers normally have a lower rate of turnover and thus spend fewer resources on training new workers. Another is that the presence of a union keeps managers on their toes, forcing them to strive harder to improve productivity in the face of union demands for higher wages.

Furthermore, over the past two decades, unions within key industries have widened the traditional workplace contract—which represents the standard adversarial positions between labor and management over wages, benefits, and working conditions—to include employee involvement in workplace decisions.

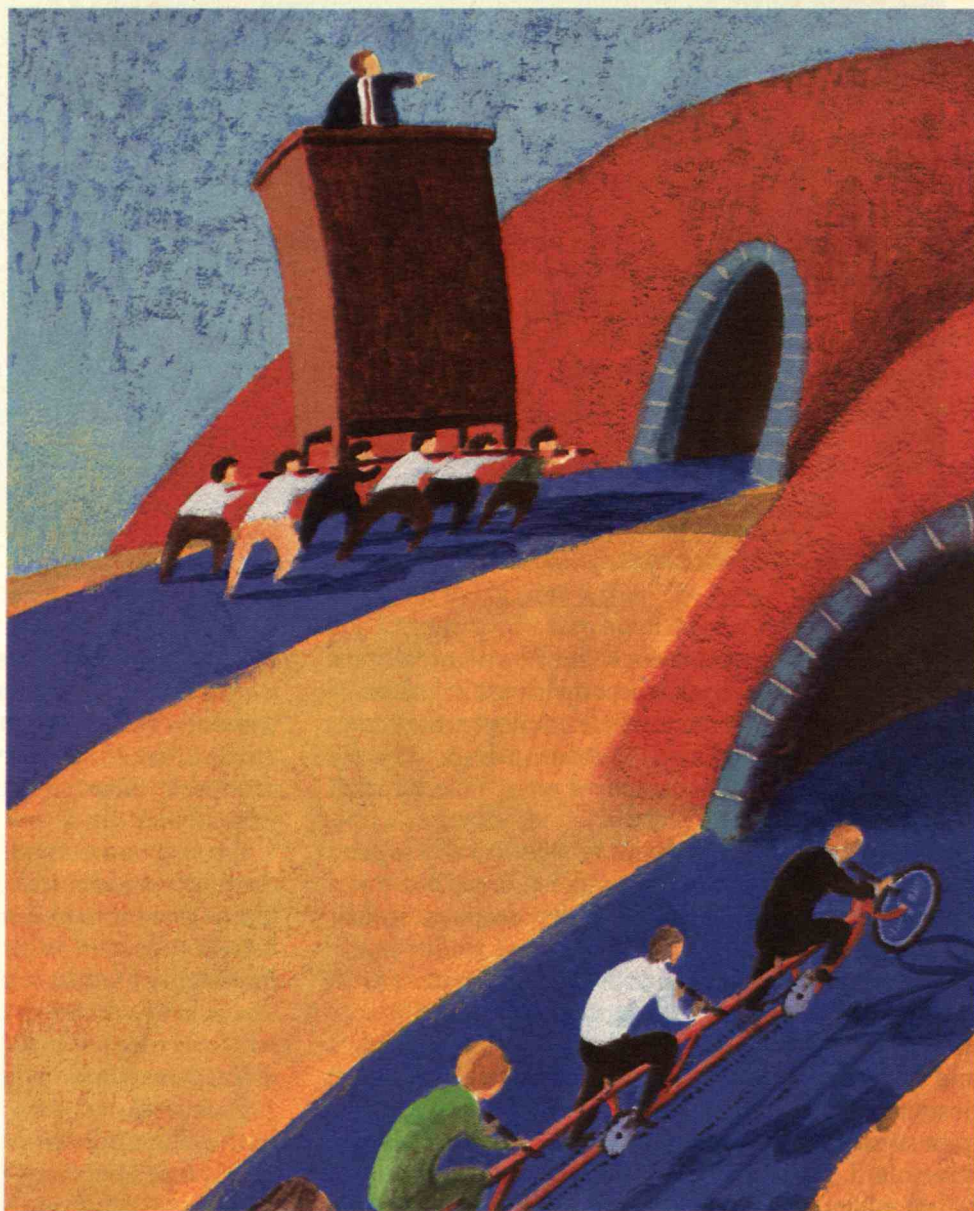
Indeed, an examination of unfolding developments points to what may be termed the creation of a three-track system of labor-management relations. Track I is represented by the traditional labor contract with a carefully spelled-out grievance procedure. Track II provides for employee involvement in the decision-making process, empowering individual employees to help determine workplace issues, such as the methods, means, and processes of manufacturing or providing services. Track III is characterized by the establishment of joint union-management committees empowered to deal with specific issues of mutual concern—problems of quality, efficiency, health and safety, alcoholism and

drug-addiction rehabilitation, child care, and a host of other issues that previously fell within the sole domain of management.

Such expanded workplace contracts have helped to change the culture of production, whether of goods or services, in the direction of improved employee satisfaction, thereby markedly boosting the efficiency of each individual job.

In practice, however, employee participation in the workplace has a mixed record in boosting productivity and output quality. Survey research and more formal economic analyses indicate that three underlying conditions are absolutely indispensable to the success of participatory programs: full commitment to the concept of involvement throughout the business organization, attainment of mutual trust and respect between labor and management, and a genuine opportunity for broad-based direct employee involvement in decision making. This amounts to, in short, democratization of the workplace. Merely setting up work teams or paying lip service to participation can be downright counterproductive.

Even where participation seems to be working, most efforts are limited to the problems of the factory floor or the office setting. They do not address the "strategic" decisions of the firm. The crucial factors that determine whether an enterprise flourishes or flounders—including pricing and accounting, design and engineering, advertising and marketing, investment and subcontracting—remain firmly within the purview of top management. Yet given the track record of American industry, it is abundantly clear that management does not have all the answers.



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Joint Decisions

Embryonic evidence suggests that joint decision making at the strategic level of the firm is already working to solve problems of productivity, quality, and innovation that have been largely immune to most other approaches. For instance, after undergoing a massive training program established in the early 1980s, teams of employees at the Campbell Soup plant in Maxton, N.C., began making traditional management decisions without direct supervision. "We turned the business over to them," says the plant's manufacturing vice-president. The teams met with vendors, set their own schedules, and even proposed capital expenditures, complete with calculations of the rate of return. A new machine suggested by one work team is so productive that it yielded an overall 30 percent return on its investment. Soon after implementing joint decision making, the plant set a record 16 percent increase in productivity in a single year.

In 1988, Northern Telecom's 420-employee switching-equipment repair facility in Morrisville, N.C., also began moving toward joint decision making. Employees are organized into "cells" that set their own goals for meeting objectives ranging from efficiency targets to turnaround times. Cell members also conduct performance reviews, interview job applicants, and set flexible work schedules. Three years after the program was installed, revenues at the facility were up 83 percent, earnings per employee increased by 93 percent, quality (as measured by returned parts) improved by 51 percent, and customer-service satisfaction (as indicated by a reduction in complaints) rose by 65 percent.

No effort in joint decision making, however, compares with the experiment taking place at Saturn Corp., the joint venture between the United Auto Workers (UAW) and General Motors to conceive, design, and build automobiles with full union participation. From the moment of conception in 1982 to the construction of a \$3 billion facility in Spring Hill, Tenn., and finally with the assembly of the first Saturn vehicle in 1990, the union was intimately involved in an extensive array of strategic decisions. In joint committees, management and workers have combined forces to design the physical plant, choose every technology used within it, devise marketing and advertising strategies, and develop the recruitment and education programs used to select and train the new GM division's workforce.

A committee of 99 individuals—55 from the union

and 44 from management—established the basic guidelines governing the decision-making process. The negotiated labor contract with the UAW is unique in that its entire structure is predicated on joint decision making, involving everyone from the president of the corporation to the employee on the shop floor. It stipulates that any party may block a potential decision but that this party must search for an alternative. And it specifies that problems are to be solved through a form of continuing negotiation, which includes the right to strike.

One of the first major decisions to result from the joint labor-management team concerned the method used in the final assembly process. The traditional practice is for workers to perform their tasks while walking alongside the assembly line as it moves to the next station. The committee rejected this approach in favor of an assembly line using moving platforms on which workers stand—in this way the platforms, not the workers, move to keep up with the line. And each platform can be pneumatically raised or lowered by the workers at a particular station so as to minimize bending and stretching. In keeping with the strict emphasis on quality, workers can temporarily stop the platform line in order to make corrections.

A Sense of Responsibility

What is special about Saturn, however, is that participation does not stop at the level of the shop floor. For example, the actual design of the Saturn automobile was determined jointly. The original car was to be a subcompact with a 99.5-inch wheel base, a weight of 1,850 pounds, and a focus on fuel economy even to the detriment of performance. But before proceeding beyond the clay model stage, the parties determined that this was not the car that customers wanted to buy. The committee decided to take dead aim at Japan's hottest-selling models, the Honda Civic and Accord, adopting a larger design with a 102.5-inch wheel base, a more powerful engine, and a sporty appearance.

The union also insisted on an aggressive pricing strategy that would challenge the imports for market share. Trade magazines speculated that Saturn's initial base price would be around \$9,000, but the Sports Sedan (SL) ended up costing \$1,000 less; the base price for the top-of-the-line Sports Coupe was set at a highly competitive \$11,775.

The Saturn vehicle is now being tested in the market-

Saturn's strategy—allowing workers to participate in all decisions regarding design, engineering, and manufacturing—appears to be working. The base-priced Saturn model was named the "best buy" of any 1992 passenger vehicle, domestic or foreign, selling for less than \$10,000.



place: after a slow launch in the middle of a recession, sales are running ahead of production for 1992. In July of this year, *Car and Driver* magazine named the base-priced Saturn the "best buy" of any passenger vehicle, domestic or foreign, selling under \$10,000. The J.D. Power survey of customer satisfaction found the 1991 Saturn the third-highest rated of all cars sold in America. Only the Japanese Luxury cars Infiniti and Lexus, each costing at least four times as much as the Saturn, had higher satisfaction scores. The major dealer complaint is that they cannot get enough cars from the factory to meet customer demand!

How important is joint decision making to the success of Saturn? This is impossible to quantify, but it is worth noting that the technology used at Saturn—with the possible exceptions of the platform-assembly process and a new "lost-foam" technique used in the drivetrain casting department—is by no means radical or revolutionary. Moreover, the prior history of GM's new introductions in the small-car market have ranged from ho-hum to disastrous. The radical rear-engine Corvair was ultimately dropped from production when it was found to be one of the most unstable cars on the road. The Chevrolet Vega, despite the hoopla that surrounded its introduction, disappointed customers by its poor performance and its high frequency of repair. And the Chevrolet Chevette sold modestly well, but could not compete in quality with the small cars exported to the U.S. by Toyota, Nissan, and Honda.

Saturn has been completely different. Its design and engineering, which still rely on some of the same company engineering staff that produced the Vega and Chevette, has met with critical acclaim. Its quality, as measured by defects per vehicle, is among the very best

in the industry in any price range. When one visits the plant itself, one begins to understand the secret. Virtually every worker at Saturn feels that he or she is responsible for the success of the division; workers constantly make suggestions for improving styling, engineering, and manufacturing techniques; and each pays diligent attention to the quality of every part that passes his or her work station.

The Enterprise Compact

As pioneering and exciting a social development as Saturn is, it stops short of the complete joint participation we feel is the key to success on a grander scale. For example, the union's role at Saturn is still restricted to consultation on design and engineering. The Saturn division must get approval from GM to introduce a new car model. And if it feels shortchanged in the amount of capital investment allocated by GM's board of directors, the division is forbidden to seek funding from outside sources.

Expanding beyond the Saturn model requires a new level of both labor empowerment and worker responsibility within the firm. Toward those ends, we propose development of an "enterprise compact" that would specify joint labor-management action over all decisions of the firm, both workplace and strategic. By way of example, a typical three-year agreement in a firm with relatively good productivity prospects might include these provisions:

1. *The union and management agree to target a mutual goal of 6 percent productivity improvement in each year of the compact. At most facilities where we have*

advanced the provisions of the enterprise compact in seminars and conferences, a 6 percent productivity goal is usually met with skepticism. More than one worker has asked how to meet such a target without simple speed-up. The answer we give is that virtually every shop and office can find hundreds of small ways to improve productivity that together can result in substantial efficiency gains.

In fact, one way to improve productivity is not by working faster but by slowing down. On a typical final auto assembly line that produces about 60 vehicles an hour, it is not unusual for 6 to 8 of these to be diverted to a repair bay. Chevrolets are repaired in the same way Rolls Royces are built—by hand and one at a time. At a slightly slower line speed, the number of “perfect” cars coming off the line is higher and overall productivity enhanced.

2. *All employees from top to bottom shall receive annual 3 percent wage increases.* With a 6 percent productivity increase each year, the enterprise is in a good position to offer 3 percent raises. Jointly setting the wage increase below the rate of productivity growth can provide the basis for an aggressive pricing strategy to rebuild market share.

3. *The company and the union agree to reduce product prices by 1 percent to 3 percent each year.* While profit-maximizing firms might choose to maintain prices in an effort to boost short-term profits, the union would likely have a strong interest in maximizing long-term market share, thereby boosting employment security. Under the enterprise compact, the union gains the right to negotiate prices along with the productivity target and employee compensation.

4. *Quality of the product will be a “striking” issue.* While a competitive price may encourage consumers to take a second look at American goods, questionable quality often makes the difference between opting for a U.S.-made product or the competition’s. Workers should be able to overrule supervisors who pass imperfect goods to meet production targets. Employees should be able to stop the assembly-line—in essence to “strike”—over quality.

5. *The company agrees to abide by a no-layoff provision.* Research has shown that repeated “downsizing” can hurt product quality, alienate customers, and actu-

ally cut productivity growth. In an organization so preoccupied with bean counting, employees are understandably anxious about where the ax will fall next; they become narrow-minded, self-absorbed, and risk-averse. Conversely, as Robert Levering suggests in *A Great Place to Work: What Makes Some Employers So Good (and Most So Bad)*, a company’s long-term commitment to its employees—making a company “just like a family”—is one of the few factors that contribute mightily to a strong reciprocal commitment. Of course, there is always the possibility of “catastrophic” downturns in a firm’s fortunes that would require layoffs. A no-layoff provision should therefore have an escape clause to handle such extreme cases, setting aside mutually negotiated funds for severance payments, job-placement services, and training and relocation allowances.

6. *The company agrees to establish with the union a bonus compensation system based on profit sharing.* In *Paying for Productivity*, economists David Levine and Laura D’Andrea Tyson include profit sharing among the main characteristics associated with higher productivity. They also note that such provisions are essentially self sustaining: workers who share responsibility for improving productivity or profits naturally want to share in the rewards, and sharing in the rewards provides a powerful incentive to improve productivity and profits.

7. *The company and the union agree that all strategic decisions will be made through joint action.* These decisions include, but are not restricted to, product pricing, the purchasing of raw materials and components, marketing and advertising, methods of production, the introduction of new technology, investments in new capital and products, and the subcontracting of production. Essentially, this last provision repeals the management-rights clause in the standard collective-bargaining agreement—the clause that cedes to management sole discretion over all decisions not explicitly made jointly under the contract.

Retooling the Workforce

The mere suggestion of such extensive empowerment of labor inevitably sets off alarms. Even those who do not automatically dismiss the idea raise two general questions. One concerns the degree of worker and union expertise necessary to han-

dle complex issues such as pricing, finance, and the introduction of new technology. To deal with this issue, companies and unions can create jointly administered training programs. The union can also hire consultants—specialists in finance, occupational safety and health, time-and-motion study, or law—to represent its interests, much as they do today when negotiating collective bargaining agreements.

The second and far more challenging question concerns who makes the final decision when consensus cannot be reached between management and labor. One solution is to decide that labor will be fully consulted, but will ultimately defer to management. An alternative is to submit both positions to a jointly selected mediator who will attempt to forge consensus. Still a third possibility is to submit the case to a neutral arbitrator or panel, which will make a binding decision.

Giving participatory management a government imprimatur could also help management and labor move toward adopting the spirit and perhaps the provisions of the enterprise compact. But the federal government has so far been a serious roadblock.

At the executive level, President Reagan's firing of the nation's air-traffic controllers when they went on strike in 1981 signaled to management that acting tough toward unions would not only be tolerated but countenanced. As such, Reagan's action touched off a period of unusually strong anti-union sentiment in the country.

At the administrative level, the appointment of conservative members to the National Labor Relations Board, the federal agency charged with preventing unfair labor practices on the part of both management and labor in the conduct of union organizing drives and collective bargaining, has tended to elevate management rights over labor's needs.

And at the legislative level, the most basic labor law in the land, the Wagner Act, has been interpreted by the U.S. Supreme Court as ambiguous about the role of labor in strategic decision making within the firm. While the act has not yet interfered with the type of employee involvement program at Saturn, it could



Participation
*turns out to work
best when organized jointly
between union and
management.*

prevent efforts to push joint participation further. One way to keep federal law from confounding participatory efforts would be to amend the Wagner Act to explicitly permit labor and management to negotiate issues of a strategic nature within the firm.

Regrettably, the Bush administration has done nothing to encourage labor-management cooperation, reverse the pro-management tilt of the NLRB, or initiate new legislation which would bring the Wagner Act into line with the thrust toward the enterprise compact. Indeed, the one agency of the federal government whose mission is to encour-

age labor-management cooperation through research, seminars, and conferences—the Department of Labor's Bureau of Labor-Management Relations and Cooperative Programs (BLMR)—has seen its budget slashed and its staff reduced.

In the 1992 presidential campaign, President Bush has not addressed the issue of labor-management cooperation in any of his public speeches. In sharp contrast, Governor Clinton has embraced the concept of the enterprise compact as part of his "New Covenant." In speeches at the University of Pennsylvania's Wharton School of Business and before the 1992 UAW convention, Clinton devoted a substantial part of his remarks to this very issue. One way to encourage the spread of a new labor-management approach in the 1990s is to have the nation's president advocate for it.

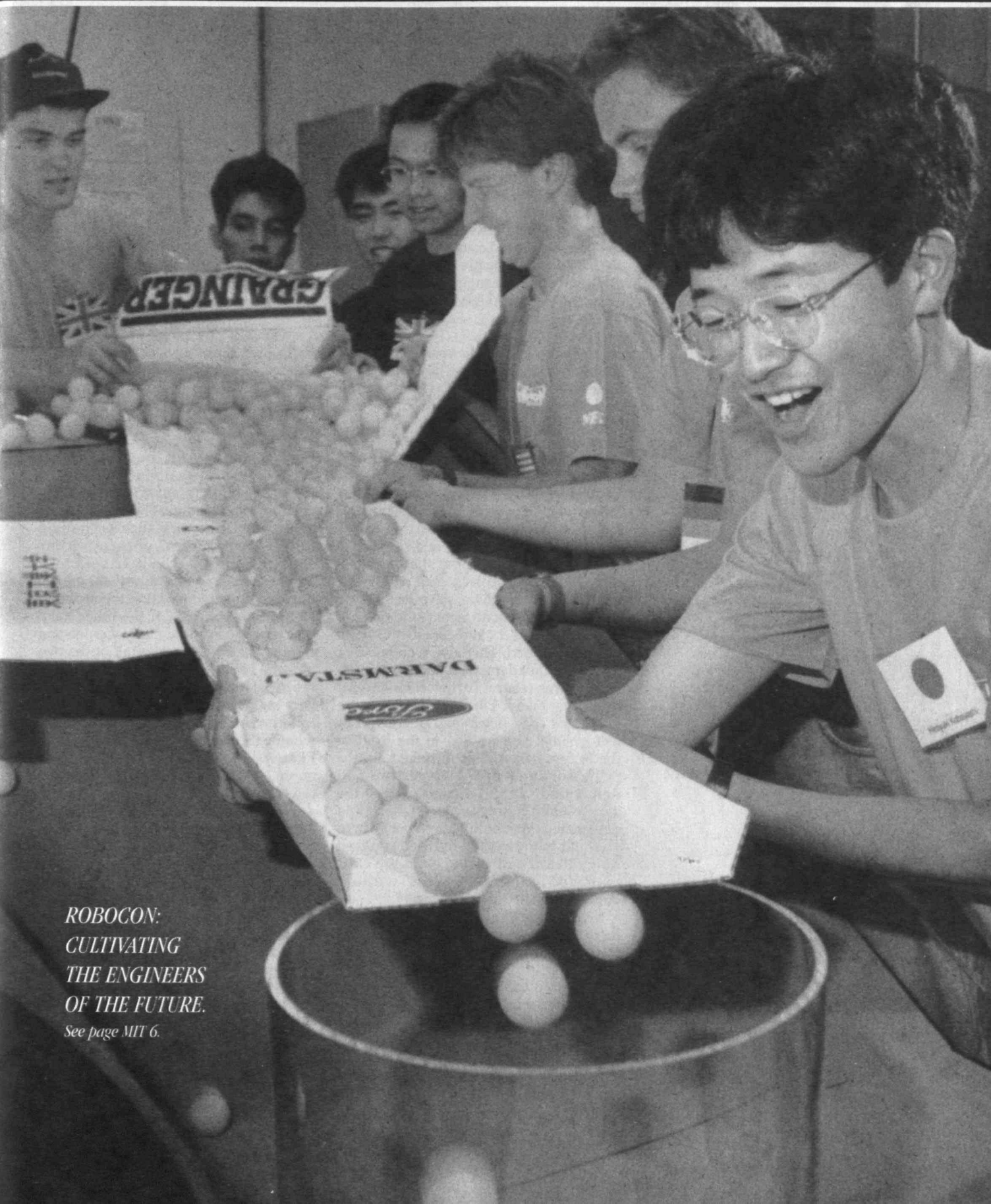
An economic renaissance can only come about with much more attention to labor-management relations and human resource management. Such a renaissance will require a profound change in attitude on the part of corporate executives and the government toward organized labor. And it will require a broader vision among union leaders of labor's role in advancing the nation's economy and the welfare of the workers they represent. Transforming labor relations from the adversarial system of the workplace contract to the all-encompassing joint-action system of the enterprise compact will be no easy task. But it is precisely the metamorphosis the U.S. production system needs. ■

FIVE YEARS, \$710 MILLION •

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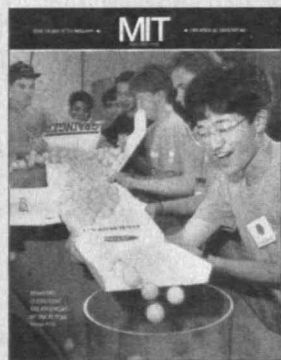


*ROBOCON:
CULTIVATING
THE ENGINEERS
OF THE FUTURE.
See page MIT 6.*



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Cover:
Within minutes of unpacking their boxes of components, members of all the teams in the International Design Competition exuberantly began playing with the kit's pieces. It was a chance to get the feel of the contest table, size up their task, and collegially horse around before they got down to serious—and competitive—designing and building. Photo by L. Barry Hetherington.

SEXUAL HARASSMENT

"Confronting Sexual Harassment at MIT" (*August/September*, p. MIT 13) causes me great disappointment. The article mentioned a guide assessing individual complaint handlers on the basis of anonymous anecdotes. That in itself is debatable. But the editor of the guide, who is quoted, also requested anonymity. Such behavior, even in pursuit of a good cause, brings no credit to that editor. Evaluating people by name while remaining anonymous is cowardice.

PAUL MANOOGIAN, '70
Aurora, Colo.

Your article on sexual harassment prompts me to relate an episode of "reversed sexual harassment" that occurred when I was an undergraduate. If you publish my letter, I would ask that you withhold my name, class, and course for two reasons: my point is more general that way and because the "villain" in this story would be easily identifiable if that information were known. I see no point in embarrassing her now.

This particular coed was in most of my classes for four years, and she would lecture us on feminism at the drop of a hat. One of our professors, a stickler on courtesy and manners, gave lectures so dynamic that they attracted students not even registered for the course and were always crowded. There were about 40 of us, of both genders, who had to sprint to his lectures from a earlier class several buildings away. Part-way through the term, this coed began arriving at every lecture late. She walked to the front of the lecture hall and stood there until the professor interrupted his lecture and demanded "Won't someone give the lady a seat?" If no one moved, he would designate someone in the front row to go stand in the rear, so the coed could sit down. All the other ladies in the class managed to get to class without demanding special treatment.

My bottom line is that sexual harassment is a two-way street. If a lady wants to work in a profession, let her act professionally.

As a divorced, single father with custody of two small children, I have experienced a whole other level of harassment and lack of social support. I suffered physical abuse at the hands of my ex-wife, as did more than half the members of a father's rights group in which I participat-

ed, and I have gone through years of litigation to try to compel the children's mother to fulfill her court-ordered child support. I have tried to travel with small children in a country where all the diaper-changing tables provided by tourist attractions are in the female restrooms. The list goes on.

Sexual harassment in our society is not just about men playing an X-rated movie on the dorm VCR and making some lady feel uncomfortable or compelled to leave. It is really about a lack of courtesy *both ways*. I resent the article *Technology Review* published on this subject because it was totally one-sided. I applaud Anita Hill and I do not condone Judge Thomas. But just because I share his gender not mean I must tolerate reversed sexual harassment.

Name Withheld by Request

The author responds: It sounds like Mr. X has a lot of things about which to be resentful, but I'm surprised he found our report one-sided. The editors and I took care to use words such as "individual" or "complainant" or even "victim" to describe people who have been sexually harassed, to avoid any suggestion that only one gender is on the receiving end of harassment. On the other hand, the article does quote many women concerning the issue, because all of the people who have organized themselves into the Ad Hoc Committee and the *Fight Back* staff in order to speak out and to tell their stories of harassment are women. Some men are involved in the Peer Advocates group, and we did quote a male faculty member critical of the Institute. I feel confident we gave a good representation of the criticisms and of the major players on this issue.

Sexual harassment is harassment regardless of whether a man or a woman is the perpetrator or whether the individuals involved are the same gender. While researching this story, I put out a call for people willing to tell their stories, circulated my card, but it was not until after the story had been typeset that I found a man willing to tell his story of being sexually harassed by a woman. His story was a powerful one, both in what it revealed about the nature of harassment and about the complaint-handling system. Had I heard it earlier, I would have included it. —Kimberly French



ALUM NEWS

Fund Thrives Though Economy Doesn't

In the last year of MIT's *Campaign for the future*, the Alumni/ae Fund set a new record of \$17.1 million. The Fund tallied gifts from 28,030 donors over the year ending June 30 and concludes the campaign with a five-year total of \$119 million in gifts and pledges.

Joseph S. Collins, director of the Alumni/ae Fund and managing director of Alumni/ae Activities, beams when he speaks about this year's performance. "The Fund has reached a new million dollar plateau every year, but not in consecutive order," he says. The FY '92 total is up \$2 million from last year and up \$900,000 from FY '90, the year of the Koch Challenge.

Outgoing Alumni/ae Fund Board Chair Karen Mathiasen, MS '71, credits the continued goodwill of alumni/ae for the year's record total. She also points to the economy, noting that "uncertainty has a negative affect on giving, and 1990-91 was an uncertain year, with the war in the Persian Gulf and the stock market crash that never came." She finds that people are again comfortable making charitable contributions and reports that many upgraded their giving to MIT this year. The Fund achieved its campaign goal of raising the median gift for undergraduate alumni/ae to \$100. Contributions of at least \$100 were received from 48 percent of all donors; 19 percent gave \$250 or more; and 6 percent gave \$1,000 or more.

Both Mathiasen and Collins believe that donors responded very positively to a number of Fund programs, specifically: the Alumni/ae Fund Visit Program, reunion giving, the Piece of the Steps, and telethons.

"This year we introduced reunion gifts for every reunion class," Collins reports. "An unprecedented 14 classes, from the 5th reunion class of 1987 to the 70th reunion class of 1922, presented gifts to President Charles Vest on Technology Day." Two of those classes broke the Class of 1923's long-standing reunion gift record of \$8.1 million: the 65th reunion class of 1927, which raised \$9 million, and the 50th reunion class of 1942—the new record holders—were led by Gift Chair Floyd Lyon to a stunning \$10.1 million.

Through the Alumni/ae Fund Visit Program, alumni/ae were organized and trained and then called on fellow grads to make the case for MIT. Collins says its goals were not solely centered on fund-raising. "We also set out to raise a new cadre of alumni volunteers that represents the diversity of the alumni body." The AFVP divided the United States into 73 regions and operated over the five years of the campaign. Close to 600 alumni/ae participated, nearly half of them first-time solicitors, and women made up an unprecedented 10 percent.

Nearly 1,000 volunteers participated in Alumni/ae Fund telethons in FY '92, both on campus and at 19 regional centers. "Without question, this is the best volunteer telethon program of any university in the United States," Collins asserts. "Most colleges and universities use paid student callers or professional solicitors. We don't know of any other institution that enlisted 1,000 volunteers." The callers contacted some 16,000 individuals—20 percent of the entire

alumni/ae body—and they brought in fully one-third of contributors to the Fund.

Another success story was Project 2000, which supports classroom renovations to meet the educational demands of the next century. By offering to donors of at least \$500 a "Piece of the Steps"—a paper-weight incorporating a chunk of the original limestone tiers at 77 Massachusetts Avenue—Project 2000 helped motivate unprecedented numbers of donors to make gifts at that level. It put \$640,000 in the renovation fund.

Although the *Campaign for the future* is over, "the Fund is always in campaign mode!" jokes Collins. As MIT and other universities face continued strains in their relationship with the federal government, President Vest says, "the independence of private support will be increasingly important." And as Vest observes, "campaigns come and go, but the Fund is always with us."

—ROBERT DIMMICK (The author is a freelance writer and assistant to the executive vice president of the Alumni/ae Association.)

After you e-mail your mother, e-mail your alma mater.

The Association of Alumni and Alumnae of MIT would like to include your electronic mail address in its database, along with your work and home addresses and phone numbers.



You can now use e-mail to notify the association of information changes, like a new address or the name of your new spouse.

All of the above can be handled by sending e-mail to MITALUM@MITVMC.MIT.EDU

If you are not online, you can send changes in your address and telephone numbers by fax to 617-258-7886, Attention Records Office.

MIT Clubs Are Alive and Well and Awaiting Your Membership!

Across the nation and around the world, MIT Alumni Clubs draw thousands of alumni/ae, parents, students, and friends to a broad range of social and educational activities. Since MIT clubs reflect the diversity of our alumni/ae body, events range from faculty speakers to career workshops, from plant tours to opera, all in an effort to promote the Institute and provide enlightenment about its programs. In addition, a number of clubs have a public service entity in which one may find people tutoring high school students or painting a shelter for battered women.

Club leadership is drawn from local alumni/ae volunteers who serve as officers or board members and often rise to positions on Alumni/ae Association national boards and committees. Each club sends out annual membership invitations, usually with their first fall event announcement. If you haven't received your invitation yet, respond now by looking up the club president or alumni staff person in your area on the following list.

We look forward to seeing you soon and often at MIT Club activities and welcome your support.

Janet Serman

Janet Serman

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A Vehicle For Multicultural Communication

2.70 Goes Global

By Michael-Jean Erard



ROOM 26-100 is packed. Dignitaries are sitting; latecomers stand along the walls. Necks crane for a better view. The referees signal go!, the buzzer sounds, a green light flashes, and a phalanx of TV-camera and sound technicians converge around competitors from the Tokyo Institute of Technology (TITECH), Cambridge University in Great Britain, the Technische Hochschule Darmstadt in Germany, and MIT—all contenders in the final event of the 1992 International Design Contest (IDC).

Insiders call it Robocon. This year, it brought 35 men and 5 women, divided into 10 teams, to the MIT campus for 10 days in August. First taken to Japan in 1990, IDC is a laboratory for "the international design of the future," in the words of its organizer, Harry West, PhD '86, associate professor of mechanical engineering. Though patterned on MIT's 2.70 design competition, which West took over from its founder, Professor Woodie Flowers, PhD '73, IDC is about collaboration as much as it is about competition. West decided at the start that IDC teams would include members from each of the participating countries.

And just like its famous precursor, this event has captured the imagination of television producers near and far. Churning, lurching machines, hesitant cardboard ramps deployed with dull pneumatic bangs, ping-pong balls cascading or dribbling into the goals, the passionate absorption of the young engineers, the rowdy enthusiasm of the spectators—all make "good video," as the TV people say. And for the dramatis personae and their communities, something else is good: television is transforming the IDC finals from an elite engineering event into powerful publicity for the engineering profession.

"People just don't know what engineers do," one student explains. When the PBS

and NHK (Japanese network) specials are broadcast, says German competitor Berkhard Wolf, they will show "that engineers are creative, that they like to play with toys." But more than demonstrations of technical ingenuity are at stake. Heather Klaubert, '94, says that "I decided on engineering because it's dealing with the real world. It's the best way to change the world around you."

Lofty goals notwithstanding, the IDC crew sees no need to be stuffy. The students laugh at allegedly being "40 of the world's brightest college students," as they are



Flanked by the flags of their countries, two of the multinational teams pit their machines against each other, as a standing-room-only crowd packs Rm. 26-100. Above: the TV cameraman for Scientific American Frontiers tries to stay on top of the action; and the jubilant winners, clad in flashy satin prize jackets, hoist their trophy.

described in an ad placed in *Newsweek* by NEC, a Japan-based electronics multinational and the IDC sponsor. They ham it up for the cameras and practice their interview skills. But they admit that TV makes them self-conscious. "I'm definitely more intense-looking and careful when the cameras are around," says one.

From the first day of this unique gathering, they heed advice from the puckish West to "get to know each other. Take time to have fun." They tackle recreation—songs, beer, soccer, frisbee, softball, bowling—with boisterous undergraduate zeal. Their version of "Swing Low, Sweet Chariot" features hand gestures, few words, and nothing appropriate for an alumni magazine. Outside Fenway Park, Dionne Chapman, '94, gives fashion advice to team member Takeo Mitsui: "Pull your shirt out of your pants, just a little, that's it," she says, explaining aside: "I want him to look cool, I don't want him to look like a nerd." Waiting for the game to start, Volker Stoll, Cameron Miner, '92, Julien Pieters, and Matt Manning, '94, compare the burns from glue guns on their forearms and tiny cuts from hand-tightened nuts on their fingertips. Though the Red Sox are winning, the Germans and British find their first baseball game boring and incomprehensible, and they leave early. The Japanese, as comfortable doing "The Wave" as hometown fans, stay to the end.

Every event does double duty. As one student explains, "You're much less likely to get frustrated with someone when you remember the good time you had together last night."

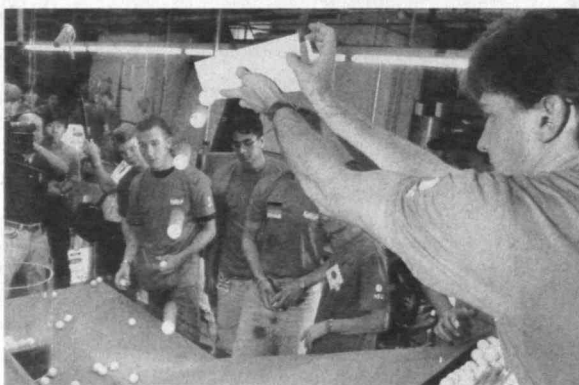
The work gets underway quickly. After the tour of the machine shop, they unpack identical boxes of aluminum rods, motors, sheets of plastic and steel, springs, gears,

and rubber bands, all donated by different companies. The students agree that teamwork is necessary, but the consensus ends there. Unsure of each other, they brainstorm, make suggestions, sketch ideas, paw through parts—and encounter the first personality conflicts. Teamwork often

involves giving in. A team without all its members is not much of a team. Team leaders are not designated, but many emerge, and they soon learn the importance of ensuring that everyone gets to speak, that everyone understands.

Each of the participants was an outstanding performer at the 2.70-style competition at his or her home school, and they all toted their winning machines to MIT. When they demonstrate their handiwork for the jury of their peers, each type of machine draws praise, applause, and a certain amount of envy. Few of the participants can resist stereotyping each other's technological strengths: machines from the Darmstadt contest are polished metallic examples of a techno-modern aesthetic, while American and British machines show rugged reliability. One student observes that Germans and British use kit components as raw materials, while Americans and Japanese tend to use them "as is." Now, designing for IDC, they have to consider the advantages of using their existing skills—replicating the features of their winning designs—versus taking on new challenges.

They not only wrestle with tried-and-true vs. new designs, but ambitious vs. "safe" designs. Cambridge's Sarah Fox notes, "We want to be creative, we don't want to be boring." Her team builds a machine with a paddle that flicks balls into the goal, a risky design that has no competitive success. Asako Takami echoes Fox's sentiments. "I want to build an interesting machine," Takami says. What's an interesting machine? "Something that drives around, picks up balls, maybe something that shoots," she replies. But in the end, she bows to the collective judgment of her team: they build a conserva-



The many faces of design and construction: Professor Harry West (top, second from right) coaches one of the 10 teams as they unpack their kit. Later, Asako Takami, the only woman from TITECH, wields the drill, while teammate Julian Peters from Cambridge University holds parts in place. And omnipresent TV crews document a team testing the bouncing behavior of ping pong balls.

tive machine and come in second overall.

The design and construction of intricate machines is only a vehicle for IDC's more compelling purpose, as West sees it. Engineers have to learn to communicate their ideas and experiences to each other, to business colleagues in sales, production, and advertising, and to the public concerned with the role technology plays in society. West and fellow IDC faculty Masashi Shimizu of TITECH, Ken Wallace of Cambridge, and Herbert Berkhofer of Darmstadt closely monitor how team members negotiate among different working styles and overcome cultural stereotypes.

Language differences are intensely felt. West urged students to build a foreign language design vocabulary, but in only 10 days, there isn't time. Says Cambridge's Julian Pieters, "It's frustrating. When you're designing something, you get momentum. You're moving so quickly, the ideas just come out, and the speed actually helps you. So it's frustrating to go back and retrace your steps and make sure your teammates understand your ideas."

Students attribute the predominance of English speech to the IDC site. If we were in Japan, the Americans say, we'd be more sensitive about speaking English and use more drawings and hand signals. The pivotal communicators however, were Germans, not Americans. West points out that the Germans at IDC are, on average, older than other students and have more hands-on experience from jobs, the military, and their university curriculum to bring to building sophisticated machines. "I've learned that Germans like to file everything," says Matt Manning, '94, about Berkhard Volk. "And my God, he welds." On top of that, the Germans' English is fluid and profi-

cient, yet they still understand the position of non-native English speakers.

But West discovered that in this year's contest, personality differences have a greater effect on group effort than cultural variations from one country to another. And a trait that would be an individual

asset in one situation becomes a detriment in another. "The students who are very aggressive during the design process are also very quick to panic if something goes wrong. Those who are unaggressive during the designing remain cool," West observes. Also, students who favor "rapid prototyping" (quickly building a testable model) are "confident and don't mind making mistakes."

Given that the range of problems faced by engineering teams of the future will be enormous, the lesson from IDC's small sample seems to be that the profession will benefit from attracting people with a diversity of working and problem-solving styles. That's one reason why the organizers believe televising the competition is so valuable. (IDC was broadcast in Japan in October, and will be aired in the United States on Scientific American Frontiers on December 2.)

MIT history supports their belief in the power of the "tube." Thomas Massie, '94, the 2.70 winner in 1992, watched a PBS program on the competition at home in Kentucky when he was in the 8th grade. "I was building things all the time. When I saw that show, I got really excited, because I knew that other people were doing the same thing I was. I liked that, the creativity of designing with what you're given. And I started thinking: what kind of a machine would I have built?" Now at MIT, Massie is building things like robots in the AI lab. The teamwork behind such projects, Massie says, has inspired him to envision starting his own company. "I intend to keep building." □

—MICHAEL-JEAN ERARD was an intern at Technology Review before graduating from Williams College in 1990. He is now a graduate student in teaching english as a second language (TESL).



In a close-up of the encounter in the opening photo, the team on the right, with the "ramp strategy," is demolishing the competition, filling their goal with ping pong balls. The center photo is one of the ambitious machines that didn't work as its designers hoped. And though ramps in general worked best, even a ramp was not a magic formula for success (bottom).

Roxbury Outreach Shakespeare Experience



Nelly Rosario, '94, an MIT student majoring in civil engineering, puts on a sweatsuit and sneakers and, standing in front of an assembly of elementary school children, transforms herself into track star Wilma Rudolph.

Computer science major Lee Morgenroth, '92, leaves campus early in the morning to introduce a group of tough and skeptical high school students at Cambridge Rindge and Latin High School to the passions of *Othello*, *Macbeth*, and *Julius Caesar*.

Electrical engineering student Leroy Jackson, '93, from South Carolina, takes on a small role in *Raisin in the Sun*—and learns how to trust the reactions of an acting ensemble.

All of these undergraduates lend their energies and enthusiasms to the diverse projects associated with ROSE—the Roxbury Outreach Shakespeare Experience—a theatrical enterprise at MIT since 1990. Spearheaded by Decima Francis, an actress and director trained at the National Theater in London, ROSE creates bridges within the MIT community and beyond. It links a multi-racial group of professional actors, MIT undergraduates, students and teachers from the local public schools, and even foreign audiences in a unique exchange.

Francis originally came to the United States in 1989 to conduct six months of acting workshops with a new troupe of professional minority actors at Roxbury Community College in Boston. She then discovered MIT—in particular, that the costume and technical departments of the Institute's Program in Theater Arts could be resources for the troupe's work in the schools. The next year Professor Alan Brody, director of the Program in Theater Arts, accepted her proposal to teach introductory acting classes at MIT and establish an on-campus residency for her company through the two-year-old Artist-in-Residence Program of the Office of the Arts.

Francis' first course focused on minority theater—issues raised when performers



Above: The cast of the Roxbury Outreach Shakespeare Experience's production of Romeo and Juliet, staged last fall in Kresge Auditorium.

Right: Two members of the ROSE troupe, David Coleman (left) and Stacy Simmons, in costume for Macbeth.

from non-white traditions are cast in classic Western scripts—and on styles and traditions that emerge from non-European cultures. This slant continues to give her work a very different starting point from other theater groups at MIT: under her direction African-American, Asian, Hispanic, and white students find themselves tackling roles in *Romeo and Juliet* alongside classmates working on Indian dance performances.

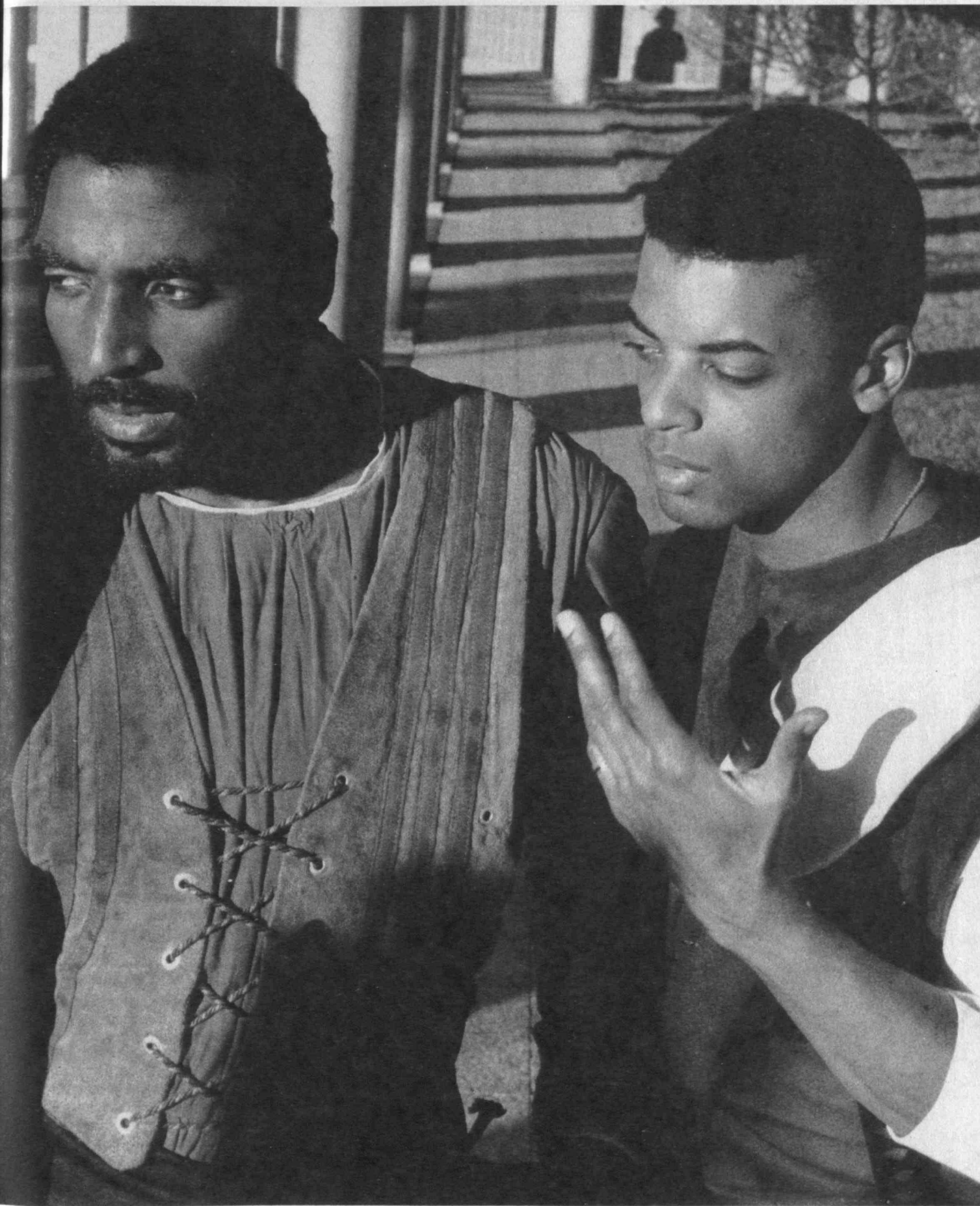
With Francis beginning acting classes are not what students might expect. Instead of memorizing scripts, they might perform breathing exercises—a step toward mastering the actor's physical resources of voice, posture, and emotions. As Nelly Rosario explains, Francis focused on "getting to know yourself, on relaxation, and on tuning into who you are before you get into acting. The biggest challenge is becoming comfortable with yourself, accepting errors, and not being afraid of looking inward. To act, you have to jump beyond your hang-ups and be open with yourself."

A similar approach applies to the Shakespeare outreach program. "One can get lost in the academic world," Francis explains "and building a community is so important. [ROSE] is a way to find people you like—to socialize and learn from each other at the same time." The role ROSE plays in the public schools is a mutually beneficial one. "We're training our future audiences," she says, "and we know that if a show works in the schools, it will work everywhere else. Children really are the best audience because they're very truthful; their response is immediate. They respond to the play, the acting, the content, and whether or not it has anything to say to them. If it doesn't, they switch you off."

Occasionally, the threads of ROSE's diverse activities come together, as they did when a small group of professional performers and MIT students spent 10 days in Jamaica during IAP '92. They presented condensations of Shakespearean themes and characters at Jamaican elementary schools, universities, and schools of drama and art. The MIT students also found themselves describing their experiences as Americans and as students majoring in scientific and technical fields. Francis spoke about how acting could be a way for engineers and scientists to deepen their understanding of themselves. And ROSE's Jamaican hosts—including the U.S. ambassador and the administrators of schools and orphanages where they performed—shared eye-opening descriptions of how this nation survives on seasonal tourism.

For the students, the IAP experience in Jamaica was also a glimpse into the hectic traveling life of a performer. Leroy Jackson especially cherishes the closeness he developed with some of the professional actors in the company. "It was wonderful to be able to have all types of conversation with them," he says, "and then see them go from that to a Shakespeare performance."

—DEBRA CASH (The author is a contributing writer at Technology Review.)





Paul E. Gray, '54

The earliest murmurings that MIT had to think about a new capital campaign were heard around 1983, early in the presidency of Paul E. Gray, '54. "I had no idea then how much time it would take, what a personal investment would be required," he says. "It absorbed the largest fraction of my energy over the last few years."

He sees the campaign as having strengthened MIT's ties with its graduates, first through heightening the profile of the Institute in areas where local folks found it to be weak, and second by engaging so many thousands of alumni and alumnae as volunteers. Gray believes an increased Institute presence can best be seen in California, where MIT has thousands of alumni/ae and where a lot of businesses have MIT roots, and he says more attention is also focused now on alumni/ae in the Midwest and Florida. "And by the way," he says, "we'd better keep it changed, not let it lapse back."

After years of cross-country and global travel, his most memorable campaign moment came when he was out of town, calling on a couple. "I was just working up to the point of asking for a career development chair, when the wife suddenly said she had to leave. My heart sank, because I hadn't done what I'd travelled there for. Then the husband said, 'Look, we know what you've come for, and we've already decided what we are going to do.'"

"In fund raising," Gray recounts, "you just hate to hear those words—'we've already decided'—because it almost always means the lowball. But then the husband said, 'We've decided we're going to give you a full professorship, \$2 million.' Had his wife not gotten up and headed for the door, I would have asked for \$600,000. Not only would I have missed out on a huge amount of support for MIT, but I might even have offended the donors!" A rule of fund raising, says Gray, is that you almost never insult or anger someone by asking for too much. "Requesting a large gift is almost always taken as a compliment." □

Over the Top to

MIT completed its five-year, record-breaking Campaign for the future June 30

with \$710 million in gifts and grants. The Institute was able to meet and exceed its campaign goals by marshalling the powerful loyalty of alumni and alumnae as well as the country's confidence in its most prestigious institution of science and technology.

The total was \$240 million above the campaign's original \$550-million goal, and it was a full \$10 million more than the revised goal—as of 1990—of \$700 million.

The new funds are "the essential base upon which MIT's future relies," says President Charles M. Vest. His willingness to take up the mantle as leader of the Institute and the campaign in 1990 must have reflected his confidence in the outcome of this endeavor, which was conceived, organized, and pursued by his predecessor, Paul E. Gray, '54, now chairman of the Corporation.

It is probably just as well that planners of the campaign in the late 1980s could not foresee the economic hazards that MIT would confront in the five-year period. The announcement of a \$550-million campaign, culminating almost two years of planning, came in the same week in October 1987 when the Dow Jones average dropped a full 500 points. In one day, the market value of MIT's endowment shrunk by some 8 percent, and the nation's economic confidence was severely shaken.

Three years later, when the campaign still had some two years to run but it was clear that the original goal would be met soon, the goal was raised to \$700 million. Three weeks later, Saddam Hussein invaded Kuwait, threatening Middle East stability and the West's supplies of low-cost energy. And during its final 18 months, the campaign came to a successful conclusion despite a recession that proved far deeper and more stubborn than most forecasters expected and from which technology-based industries enjoyed no immunity.

But every cloud turned out to have a brilliant silver lining.

Just as the campaign was announced, an

unprecedented two Nobel Prizes for 1987 came to MIT—to Professors Susumu Tonegawa, in physiology or medicine, and Robert M. Solow, in economics.

On another front, MIT's new Leaders for Manufacturing Program began attracting national attention and support. A joint effort of the Schools of Engineering and Management, the program to provide graduate education for future leaders of U.S. manufacturing industries attracted some \$54 million in funding from major corporations.

The campaign's opening day was enlivened by the announcement of a \$6-million gift from its honorary chairman, Cecil H. Green, '23—the nucleus of a fund for a new center for teaching and research in the many branches of physics represented at MIT.

Focus on People and Programs

Green's gift was one of the few major contributions focused on new facilities. This campaign, unlike its predecessors, was aimed at enhancing support for people and programs. It was a goal whose time had come, for MIT's various constituencies understood that the Institute's endowment—the capital that generates income for education and breakthrough research—was seriously deficient. Now the situation is much improved, according to Glenn P. Strehle, '58, vice president and treasurer, as the endowment presently exceeds \$1.61 billion, up by about one-third over pre-campaign levels.

Of the gifts for endowment, \$104 million was designated to establish faculty chairs. In addition, the campaign generated \$117.5 million of endowment for student support, \$339 million for academic programs, and almost \$131 million for unrestricted funds. Less than \$19 million was given specifically for facilities.

Strehle, who is the Institute's chief fund-raising officer, especially notes the large component of unrestricted gifts. Such gifts indicate special confidence in MIT on the part of their donors, he says. By relinquishing the opportunity to suggest how their dollars are to be spent, donors of unrestricted

\$710 Million

ed funds provide MIT with flexibility to meet shifting research and teaching needs.

Professor Mark Wrighton, provost, speaks with deep conviction about the campaign's effect on support for faculty chairs and for student financial aid.

Since 1987, 92 new faculty chairs have been endowed: 58 full professorships and 33 career-development chairs for junior faculty. Donors range from individual graduates or classes to corporations and foundations; a chair may be named for the donor or a loved one, or pay tribute to a respected faculty member, classmate, or employee.

To the teachers who benefit from these new endowments, named professorships are an honor that brings both prestige and resources. Discretionary funds that accompany a professorship make possible such things as professional travel, support for graduate students, and purchase of new equipment.

And the assurance of an endowed chair means "not having to worry about the consequences of failure," Wrighton explains. "Too often, people in the academic world are risk-averse. They do safe, predictable research projects so that they'll be sure to end up with results. But when you know that you'll still get funds next year no matter what happens, it's amazingly liberating. It encourages you to take risks that can lead to pathbreaking discoveries."

Maintaining What MIT Stands For

Equally important, Wrighton says, is the millions for student support. Those funds, he says, will help maintain MIT's long-standing "need-blind" admissions policy that assures all qualified students the opportunity to enroll regardless of their financial resources.

Income from the campaign's new endowment will curb MIT's need to divert substantial amounts from its general operating budget to provide support for needy students. "In many people's minds, building endowment in the area of student aid is essential to maintaining what MIT stands

for and what it's all about," says Wrighton.

In addition to its support for faculty and students, the campaign has underwritten important new academic initiatives. "The campaign's solid base of financial support," says Vest, "will give MIT both the flexibility and the independence to turn its attention toward important scientific and technological concerns as the 21st century unfolds."

Among the many new programs already identified:

- The State Street Foundation, administered by Boston's State Street Bank, has provided a Science Partnership Fund to promote the work of young investigators in the School of Science whose interests cross the boundaries of traditional disciplines.

- A gift from the Dibner Fund of Wilton, Conn., will establish the Dibner Institute for the History of Science and Technology at MIT and move the 40,000-volume Burndy Library of rare books and instruments from Norwalk, Conn., to the MIT campus. The Dibner Institute funding includes an endowed professorship and support for graduate students in the history of science and technology.

- Contributions to the School of Architecture and Planning and its affiliated Media Laboratory have grown more than 20-fold during the campaign years. There have been generous gifts and grants for professorships as well as gifts that fund new programs, including a new student photography laboratory given by Ronald A. Kurtz, '54, in honor of photographer Berenice Abbott; and \$187,900 from an anonymous donor to support teaching and research on new ideas in building technology and construction.

- Enhanced strength in undergraduate education is promised by the MacVicar Faculty Fellows program, funded by campaign gifts that include \$1 million from the Exxon Educational Foundation in memory of the late dean for undergraduate education, Margaret L. A. MacVicar, '65. The fellowships reward faculty members for outstanding contributions in teaching and curriculum development, and typically include salary support and annual discre-



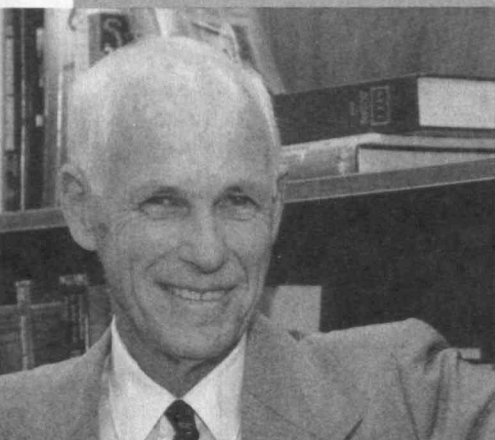
Carl M. Mueller, '41

If you think about the central events in the recent management of the Institute—choosing Presidents Gray and Vest, for example, or the last two capital campaigns, or the last 20 years of deliberations by the Executive Committee of the Corporation—Carl Mueller was a major player in all of them. And in classic MIT fashion, when discussing his most recent achievements as chair of the Corporation Campaign Committee, he speaks most of hard work and lessons learned.

What he learned from this campaign, he says, is that hard work is best invested in establishing and maintaining informed connections with friends of the Institute. It's a process, he acknowledges, that can involve years of attention from volunteers and staff. "Whether it is a million-dollar donor or a thousand-dollar donor you're talking about, my experience is that you do better over time if you pay more attention to people."

Mueller's committee had primary responsibility for soliciting gifts of \$500,000 and more, and he was already mobilizing that effort from an office on campus by 1985, a full two years before the official launch. From his vantage point of intense involvement, Mueller is in a good position to extend the military metaphor implied in the word "campaign." The premier campaign impact on MIT, Mueller remarks, will be the development of "a much better peacetime army"—folks in the trenches, both staff and volunteer, superbly organized and battle-seasoned.

And the fight for the resources to maintain the Institute's premier status is not going to slow down. Commenting on the change in our relationship with government, Provost Wrighton notes that "some faculty members might be tempted to say, 'Where did all the money [raised in the campaign] go? I am not any better off than I was before.' What they don't realize is how much worse off they would be if there had not been a *Campaign for the future*." □



D. Reid Weedon, Jr. '41

In the fund-raising world, Reid Weedon is a force of nature. To expect him to operate any differently after the *Campaign for the future* officially ended on June 30—not that anyone did—is rather like saying that the hurricane season extends from this date to that date, exactly.

Driven by what he calls a “nagging memory that when the campaign started, MIT’s minimum needs were calculated at \$1 billion,” he is still at work in the temporary office he set up in Building 9 when he agreed to take on the task of national chair of the largest fund-raising drive in MIT’s history.

He observes: “There are several people who delayed making decisions about their campaign commitments, and others we didn’t even find until late in the campaign. I have four requests for full professorships outstanding, and I know of several interested alumni who came to campus visits and then were not contacted again. To my mind, there’s some important unfinished business, and I’m not willing to stop until it’s done.”

The first time that he ever asked a donor for \$1 million was on behalf of the Boston Museum of Science, more than 20 years ago. His success on that occasion surprised him, but he has had many opportunities to taste success since he cut back to half-time as senior vice-president at Arthur D. Little Co. in Cambridge in 1986 and hit the campaign trail for MIT.

“I remember going with a staff member to see a man who’d never been approached by MIT. We were with him for about 40 minutes, and when we left, he shook our hands and said he’d give us a million dollars,” Weedon recalls. Moments like that more than made up for the few instances where he was stood up, or even the one occasion when he was literally thrown out of someone’s home. “That had to be the low point,” he grimaces.

But again and again, people came through. “It really felt good when someone listened to our case, then said, ‘Yes, I can do that.’” □

Endowed chairs allow faculty to take risks that can lead to pathbreaking discoveries.

tionary allowances of \$5,000 for research, travel, and other educational activities. MIT hopes eventually to have a \$10-million endowment to fund up to 80 faculty members for 10-year terms as MacVicar Fellows.

■ A \$3 million fund to support environmental education at MIT given by Lee Martin, ’42, and his wife Geraldine was part of a sensational \$10.2 million 50th reunion gift from the Class of 1942.

A Triumph of Teamwork

The *Campaign for the future* was both unusual and strong, says Strehle, because it was a community-wide effort involving many alumni and alumnae, faculty, and students as well as the Institute’s professional fund-raising and alumni-relations staffs. Outstanding among campaign activities were personal calls by staff and alums on potential donors, faculty and student presentations during campus visits by interested alumni/ae and friends, and a series of special events throughout the country and even overseas. Strehle estimates that nearly one-quarter of the faculty helped carry MIT’s message to donors and potential donors during the campaign. “Their spirits were unflagging,” he says, “and their contributions invaluable.”

Some principals—including Vest, Gray, Executive Vice-president of the Alumni/ae Association William J. Hecht, ’61, and the two national volunteer leaders, D. Reid Weedon, Jr., ’41, and Carl M. Mueller, ’41, (respectively, national campaign chairman and chairman of the Corporation Campaign Committee)—logged thousands of miles while visiting with donors to answer questions and propose funding opportunities.

But it would be impossible to overestimate the importance of the rank and file of MIT alumni/ae in the campaign achievements. Some 55 percent of all alumni/ae for whom the Institute has addresses—about 40,000 individuals—made commit-

ments during the campaign, according to Joseph S. Collins, director of the Alumni/ae Fund. The level of annual alumni/ae giving to MIT nearly doubled between 1987 and 1992. And they were as generous with their energy as with their money: in all, something on the order of 3,000 alumni/ae labored for MIT during the five-year campaign period—an effort no professional staff could possibly duplicate or replace.

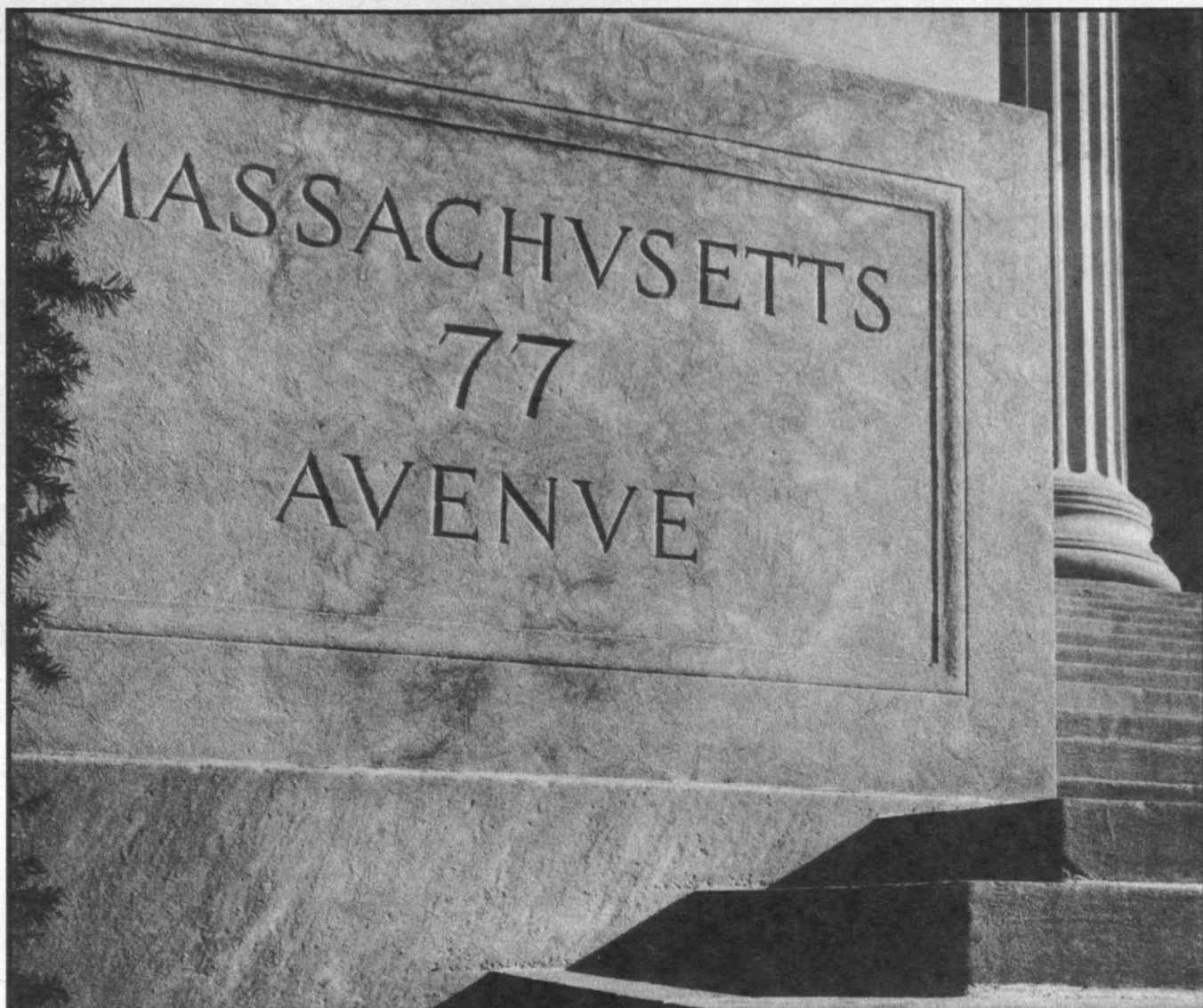
Despite the campaign-end celebrations, the Institute leadership has words of caution about the future. Paul Gray is very mindful that even the campaign’s final total is not enough to cover the entire list of pressing needs, estimated to cost more than \$1 billion when it was compiled in 1987. And with inflation taking its toll and government support steadily declining—especially for undergraduate and graduate student tuition—the need for private funding has grown.

There is a substantial need for improved physical facilities that was not addressed by the campaign—demands for plant maintenance and classroom renovation and commitments such as interest on the bonds funding the new \$60-million biology building, now under construction on the corner of Ames and Main Streets.

Median levels of alumni/ae gifts went up during the campaign, as did the intensity of efforts by both volunteer and professional fund-raising and alumni/ae-relations staffs. Sustaining those elevated levels is vital to MIT’s future.

But Gray is confident. He notes with great satisfaction that the campaign served “to educate a good number of individuals and organizations all over the world about the importance of philanthropic support for institutions like MIT,” and “to raise the sights of these people about the special qualities of this institution and the appropriate level of giving for its support.” □

This campaign report is taken from articles prepared by THERESA PEASE, the associate director of Resource Development Communications.



Christopher B. Moore G, *Technique*

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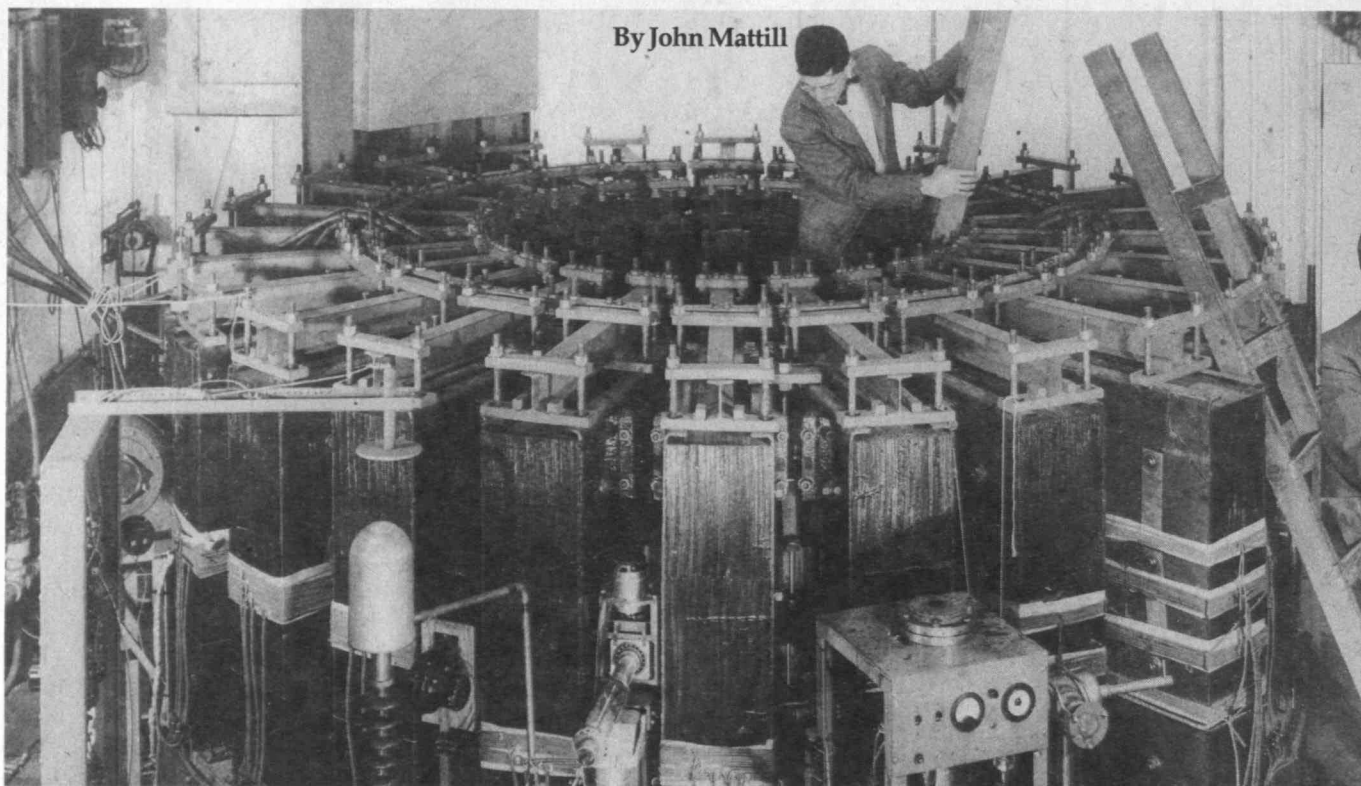
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LNS

46 Years as a Jewel in the Crown

By John Mattill



When the Laboratory for Nuclear Science and Engineering (LNSE) set up shop in 1946, its chief advocates, the late Professor Jerrold R. Zacharias and his assistant, Malcolm M. Hubbard, '29, had a bold plan that could have been entertained at no other U.S. academic institution. This interdepartmental laboratory, they said, could gather into one collegial environment many of the major players in experimental and theoretical nuclear physics, cosmology, inorganic chemistry, and chemical, civil, mechanical, and nuclear engineering. They were looking to recreate in peacetime the energizing synergy that had characterized U.S. science and technology during the war.

It was an important experiment in management for MIT and even for science. LNSE had to walk a tightrope to bring together the Institute's nuclear scientists and engineers—many of them personalities to reckon with in their own rights—while preserving the authority of academic

departments over curricula, theses, and degrees. In his annual report for 1946, President Karl T. Compton expressed his hope that LNSE would prove a "highly satisfactory answer" to a set of vexing problems that typically jeopardized interdepartmental academic undertakings.

The fundamental questions about the origins and nature of matter that LNSE addressed are still unanswered. But almost from the beginning, this has been the largest and arguably most productive academic group in the United States in a field characterized by rapid change and proliferating complexity. To celebrate its success and pay tribute to its pioneers, the laboratory mounted a two-day retrospective symposium last spring.

In sessions on theoretical and experimental physics, almost a score of the past and present leaders of the laboratory, including three of the five Nobel laureates associated with LSNE, offered glimpses of a future for physics "every bit as bright and unpre-

dictable as the past," in the words of Professor Lee Grodzins, chair of the symposium committee. And a session on the history of the laboratory, with remarks by Institute Professor Emeritus Victor Weisskopf and others, looked back on what Grodzins described as "an era that changed the way we think about the world."

When LNSE was founded as MIT's second major interdepartmental laboratory, physicists were talking about electrons, protons, positrons, neutrons, beta and gamma rays, photons, muons, and perhaps neutrinos—and about an elusive unifying theory that would tie all these together. It was an appealing vision. "We didn't have to persuade outsiders that what we were doing was important," recalled Professor Emeritus Martin Deutsch, '37, at the colloquium. Deutsch became one of LNSE's original members when he returned to Cambridge from Los Alamos in 1946.

Ever since its founding, LNSE has described itself as a tree, with each branch



Left: In this 1951 photo, graduate student Sargent Janes, PhD '53, was at work on MIT's 300 MEV synchrotron, then the largest of the research tools in the arsenal of the five-year-old Laboratory for Nuclear Science and Engineering. The inset shows LNSE's first "high command": (from left) Professor Edwin Gilliland and lab founders Professor Jerrold Zacharias and Malcolm Hubbard, '29.

and sub-branch growing on the work that had gone before. At first there were seven main stems: low-energy physics, including radioactivity and isotope production with the Van de Graaff machines and the cyclotron; medium-energy physics (the 12-million-volt electron accelerator); high-energy physics (the synchrotron); cosmic ray physics (MIT's entry into astrophysics and cosmology); nuclear chemistry (including the chemistry of isotopes and other radioactive decay products), nuclear engineering (the design of the MIT research reactor and its potential uses in physical and biomedical research); and nuclear and particle theory. Almost all of this work was supported under a single \$1 million contract with the Office of Naval Research that gave MIT scientists great freedom to do whatever they deemed most important.

In 46 years, the seven-branched tree has been pruned. The laboratory changed its name (from LNSE to LNS) as the Department of Nuclear Engineering took over the

MIT reactor and other work on applied nuclear science. Work on cosmic rays moved to the Center for Space Research in the 1960s, and the research programs in nuclear chemistry were phased out.

But the remaining tree is tall and strong. On its roster are close to 400 people—40 faculty, more than 80 graduate and undergraduate students, more than 100 staff scientists, 115 support workers, and many visiting scientists. It operates one medium-energy machine, the William H. Bates Linear Accelerator, which produces electrons with up to 1 gigavolt (1 billion volts) energy.

An indicator of the strength of LNS has been the key roles the laboratory and its members play in research at major world centers. Victor Weisskopf, on leave from LNS when he served as director of the European Center for Nuclear Research (CERN) near Geneva from 1961 to 1965, is a leading statesman of physics. Professor Samuel Ting, whose 1976 Nobel Prize was MIT's first in physics, now leads an international team building a five-story, 10,000-ton detector to study the particles that will be created in the extremely high-energy electron-proton collider at CERN. A new domain of neutrino physics is being studied with a holographic bubble chamber designed and built at MIT for the Fermi National Accelerator Laboratory near Chicago. Detectors are also being developed and tested at MIT for the Stanford Linear Accelerator and for the heavy-ion collider at Brookhaven National Laboratory on Long Island. And if the superconducting supercollider does go ahead, LNS will provide one of its major detectors.

It is no accident that most of these assignments involve designing and building equipment as well as analyzing and interpreting results. Indeed, says Associate Director Frederic Eppling, the laboratory has "a history of fabricating things" that is consistent with its origin and environment in a major technological institution.

As the hardware of high-energy physics

has changed, so has the thinking—and even the language. The question that motivated most LNSE/LNS research in its first 25 years—"What is the force that holds the nucleus together?"—is now a non-question, says Lee Grodzins. The catalog of fundamental particles that interchangeably exhibit either mass or energy now looks almost like an infinite Chinese puzzle, with particles within particles within particles—quarks of many kinds, gluons, weak and strong forces, leptons, taus, strangelets. The interactions between them are now described in terms of fields instead of forces. The world of nuclear physics is now far more fluid than was conceived in the 1940s and 1950s—a "profound revolution," says Grodzins.

Through this sea change in understanding, the laboratory conceived by the visionary young Zacharias still holds its position as a jewel in MIT's crown. Nobel Prizes may be a simplistic measure of excellence, but they are persuasive: in addition to Ting, four physicists with close ties to LNS have received Nobels: Professors Jerome Friedman (1990), Murray Gell-Mann, PhD '51 (1969), Henry Kendall, PhD '55 (1990), and Burton Richter, '52, (1976).

LNS receives the same kind of programmatic support from the Department of Energy that it once enjoyed from ONR and later from the Atomic Energy Commission. Eppling, who is LNS's chief financial officer, says that although Washington is asking for "ever-more-detailed [budget] information," LNS's management still achieves "remarkable fluidity" in using funds. "To a considerable extent," he says, "money can be spent where it will do the most good, and people can be supported in fields in which they most want to work."

Where else can a 45-year veteran of the MIT faculty like Weisskopf rejoice that in all that time, he has never had to write a funding proposal to a Washington bureaucrat? Yet he has always had financial support through LNSE/LNS "for something I really wanted to do." ■



CLASS NOTES

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Please send news for this column to: **Don Severance**, acting secretary, 39 Hampshire Rd., Wellesley, MA 02181

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Please send news for this column to: **Max Seltzer**, secretary, 865 Central Ave., Needham, MA 02192

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I thought our readers would like reading that I had talks yesterday with **Doc Flynn** and **Don Way**. Each classmate was in his advanced years but fully aware of our conversation. Both Way and Flynn and yes, me, too, were having some health problems but glad to be up and about and breathing. I told them that I'd report to you in these notes that they are meeting the challenges as good 1919ers. They are still rooters for 1919.

I regret to report the death of **George W. Cann** on December 30, 1991, who lived at 202 Tomahawk Dr., Conestoga, Penn. He is survived by his widow, Mrs. George W. Cann, Bonnie. George took Course XIII and was employed by General Electric Co. in the Turbine Department, in West Lynn, Mass. I wonder if at the time he might have known that I installed one such turbine for the Singer Co. in St. Jean, Province de Quebec.

With my best wishes to the remaining classmates of MIT 1919, I remain, too, as your class secretary.—**W.O. Langille**, secretary, P.O. Box 144, Gladstone, NJ 07934

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Please send news for this column to: **Harold Bugbee**, secretary, 313 Country Club Heights, Woburn, MA 01801

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The only news I have this month is the death of **Richard P. Windisch** of Naples, Fla., on May 4, 1992. I used to see Dick when my wife and I went to Sarasota in the winter. He was a fine chap. If my memory is correct, he and **Francis Blewer**, who died within the past few years, were partners in a brokerage firm. Our condolences are extended to his wife, Margaret.—**Sumner Hayward**, secretary/treasurer, Wellspring House E64, Washington Ave., Ext., Albany, NY 12203; **Samuel Lunden**, assistant secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274

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Good news from our classmate **Lee Carrol**: "I'm very lucky to be in good health. We just returned from a 200-mile sail in the Caribbean on a Catama-

ran-48! Did a lot of snorkeling and had wonderful weather. I live in Florida for six month in the winter. My address is Quail Ridge Country Club, 10671 Quail Covey Rd., Boynton Beach, FL 33436, where there are several MIT men but no '22ers. Saw **Frank Kurtz** in April who seemed in pretty good shape from his stroke six or seven years ago."

I would like to share these excerpts from the letter of Rosalind Williams, Associate Professor of writing and technology services, recipient of the Class of 1922 Career Development Professorship: "In a few weeks my class of 1922 Professorship draws to a close... I would like to share these reflections with you, because the generosity of your class has enabled me to keep moving ahead with my research at an especially busy period of my life... Your assistance... will help me considerably in moving forward with my project 'The Pathways of Modern Life: A Cultured History of Large Technological Systems'... The Class of 1922 chair makes it possible for me to travel freely. I am well aware what an enviable situation this is... In summary, the Class of 1922 Career Development Professorship has given me time and resources to move forward my scholarship under circumstances where it would have been difficult to do otherwise. I am deeply grateful to the (Class of '22) for the opportunities this gives me. Even though the official term of the Professorship ends soon, my appreciation will endure."

Your new secretary sadly reports the death of **E. Irving Bell, II** in 1991.

On the cheerful side, a letter from still very active **William B. Elmar** (who made it to our 70th Reunion) reports, "I'm an incurable optimist and fully expect to live to be 100. My book *The Optical Design of Reflections* continually sells all over the world." Bully for you, Bill. Keep up the good work!

As for the three "female students" who attended our 70th reunion, we are all still working. **Marjorie Pierce** as architect; **Bertha Dodge** and I still writing.

Please send me your news.—**Martha Munzer**, secretary, 4411 Tradewinds Avenue-East, Lauderdale-by-the-Sea, FL 33308

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70th Reunion

Save the dates, June 2-6, for our 70th Reunion. By now you should have received a letter from our class president and reunion chair, **Royal Sterling**, who is working out the reunion details. Write to him if you plan to attend (or think that you might) at: 2350 Indian Creek Blvd. W., Apartment D-201, Vero Beach, FL 32966 or call (407) 562-3937. Also, donations to help with reunion expenses should go to your secretary: **Fred Almquist**, 19 Griswold Rd., Wethersfield, CT 06109

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I received a copy of a charming letter written by Jane Bagby Cole, daughter of **Walter Bagby**. She was thanking Col. **Henry Stern** for his thank you for Walter's contribution to MIT. She writes, "Although blind, he always wants to hear news from the Class of '24, so whenever there is a *Technology Review* in the mail, I read him the news of the class. In addition to the column written by you and Kathy Hereford, he listened with great interest to

the report of **Luis Ferre's** award from President and Mrs. Bush."

And your co-secretary wonders if all noted the picture in the July *Technology Review* opposite our column of **Luis Ferre** and President and Mrs. Bush. Quite impressive. Walter Bagby's daughter goes on to say, "At one of the MIT reunions, perhaps the 50th, my parents spent some time with Luis Ferre, his sister, and his sister's husband (also an MIT graduate). My father recalled hearing from Mr. Ferre's sister that their father had gone to Panama as a young man from France to help build the Panama Canal and eventually settled in Cuba (where Luis was born). When my parents visited Puerto Rico, they were entertained by Herman Ferre and his wife, so had good memories of all the family."

"I believe my father has not told you that his wife, Frances (my mother), died June 4, 1991. Besides her husband, she is survived by two daughters, six grandchildren, and eight great-grandchildren."

"Even though I don't think he will be traveling to the 70th Reunion in 1992, my father will be interested in hearing news from other classmates. He's still sharp (aren't all MIT graduates?), but since his eyesight is gone, he now gets most of his daily information from the radio and conversations with friends."

From the Alumni/ae Association I have learned of the death of **Homer S. Davis** on June 6, 1992. The only information I have is that he is survived by his widow, Dorothy. My condolences to Mrs. Davis.

Your writer has returned from The Netherlands after a fantastic trip. This column is being written early since I am off again August 1, this time to Scotland for 15 days. I am truly looking forward to the journey. I understand Scotland is beautiful!—Co-secretaries: **Katty Hereford**, Box 5297, Carmel, CA 92921; Col. **I. Henry Stern**, 2840 S. Ocean, #514, Palm Beach, FL 33480

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Sam Spiker has come to the rescue of your secretary. He notes that he was the only representative of the Class of 1925 at the Technology Day luncheon last June and had the honor of sitting beside Max Seltzer, '18, the only representative of the oldest class in attendance... Sam recommends that all look at the May/June *Review*, page 56, and if you haven't previously noted the ad for the MIT Life Income Funds, read about **John M. Campbell**. John is the retired director of the GM Research Laboratories.

Sam also provided some information regarding Class VP **Don Taber**. The Springfield, Mass., *Union News* reported on October 25, 1991, that Don had donated an art collection valued at more than \$50,000 to the Holyoke Community College (HCC) Foundation. In addition, according to HCC's President Bartley, Don also donated an undisclosed sum for the upkeep, preservation, and display of the artwork. On May 27, 1992, the HCC Foundation hosted a dinner and reception, called "A Feast of Fine Art," to celebrate the gift of The Donald and Wilmina Taber Collection. Don wrote Bissell Alderman, '35, that "the dinner and reception were superb. I doubt Holyoke ever saw the equal." The collection consists of 39 works of art produced during the last 150 years—16 oils on canvas, 9 watercolors, 5 etchings, 4 color lithographs and several other items! Some of the works included are Martin

Rico y Ortega's *Venice Canal Scene*, Louis Charles Moeller's *The Businessmen*, Charles Curtis Allen's *Troy Hill in Winter*, and Russell Butler's *Sunset Through the Mist*.

Ken Reynolds has written Alumni Headquarters thanking friends for sending greetings on the occasion of his 95th birthday. He reports that he keeps quite mobile, attends church regularly, and works frequently on the garden. Ken was on the civil engineering staff from 1920 to 1944 and obtained a master's degree in 1925. An ScD came later. Many classmates may have had Ken as an instructor in hydraulics. He made the subject interesting and easy to take.

So much for the good news. The passing of two classmates must be reported. A note from Mary Larcher told us that her husband, **Arthur Larcher**, of Hockessin, Del., died June 13, 1992, at the Christiana Hospital. Arthur was employed for 40 years as a chemical engineer at the DuPont Co., retiring in 1965. He did high-pressure research at the company's Experimental Station and held several patents. He belonged to several engineering societies and enjoyed wood working, photography, and fishing. Arthur is survived by his wife and a sister, Katherine Savage of North East Harbor, Maine.

Albert S. Golemon died November 23, 1991, in Palm Springs, Calif., as the result of an auto accident. Albert received an SB in architecture from Auburn University and obtained a master's degree in 1925 from the Institute. He received a diploma in architecture from Ecole des Beaux Arts, Fontainebleau, France, in 1927. He was awarded an honorary Doctor of Humanities degree from Auburn University in 1978. Golemon served on the Corps of Engineers in World War II with the rank of Lt. Colonel. He was the founding partner of Golemon & Rolfe, Architects, in 1946, and of Golemon & Rolfe Associates, Inc., in 1953, both from which he retired in 1980. He was a fellow in the American Institute of Architects and served the architectural profession in many capacities for the Houston Chapter, AIA; was president of the Texas Society of Architects in 1953-54; and was regional director to the American Institute of Architects, 1954-57. Albert was president of the Texas Architectural Foundation in 1956 and was a member of the National Architectural Accrediting Board, 1957-63, where he served as president in 1963. He was Chancellor of the College of Fellows of the American Institute of Architects in 1973. Albert is survived by his wife of 61 years, Elizabeth Perkins Golemon, and a daughter.—**F. Leroy (Doc) Foster**, secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

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No good news for this issue. We have lost two more classmates. They are:

Isaac W. Gleason ("Ike") of Middlebury, Vt., died May 21, 1992. He was born in Jerusalem, Palestine, in 1902 and earned both a bachelor's and master's of science degree from MIT. He began his professional career in the telephone and electric-power industries in 1927 with ITT, with assignments that took him to Cuba, Chile, Argentina, Greece, Australia, southern Rhodesia, Alaska, and the U.S. Virgin Islands. He accepted a commission in the U.S. Army Signal Corps during World War II, served in North Africa and Italy, and was awarded the Crown of Italy and the Order of the British Empire by the Italian and British governments, and the Legion of Merit by the United States. He was recalled and served two years at the Pentagon during the Korean conflict. He retired to Hendersonville, N.C., in 1964, and later to Weybridge. He is survived by a son, seven grandchildren, and six great-grandchildren.

Naomi Cocke Turner of Arlington, Mass., died May 12, 1992. She was the wife of the late Clair E. Turner, and is survived by a daughter, a son, seven grandchildren, and seven great-grandchildren.

Please send news to—**Donald S. Cunningham**, secretary, Eventide, 215 Adams St., Quincy, MA 02169, (617) 328-1840

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Edward A. (Ted) Leach of Springfield, Ill., who with wife, Betty, attended our 65th are proud of their son Edward's latest business venture. He is founder and producer of New England Marionette Opera Theatre in Peterborough, N.H.—a unique theatre for performances where the costumed figures move and act in synchrony with the best recorded opera music. The building was specially designed and constructed to accommodate the marionette company.

Larry Grew has received a letter from the son of **Selim O. Lunden**, civil engineer, who died on July 16, 1992, in West Hartford. He was an engineer with the Connecticut Department of Transportation for 43 years. One of his largest projects was to establish the right of way for Route 44 from Hartford to Salisbury. Later he worked as chief of utilities managing contracts on construction projects. He also was a land surveyor.

After retirement in 1972, he enjoyed travel. He was an avid bowler, golfer, gardener, and bird lover. He ushered at Bushnell Memorial Church and stayed very active until last year when back trouble and poor eyesight slowed him down. Selim was predeceased by his brother **Eugene B. Lunden**, also a civil engineer.

Arthur Dunlevy of North Falmouth, Mass., died on May 1, 1992. He studied mechanical engineering at MIT in 1924 and 1925 and is listed with our class. His widow, Viola, stated he was a retired civil engineer for the State and was a World War II veteran of the Army Corps of Engineers.

Winfred F. Dunklee of Hamden, Conn., died on July 25, 1991, as recently reported by his widow. We are sorry we have no information on file about his life.

Robert C. Wallace of St. Charles, Ill., died on April 21, 1992. He was an eminent automotive engineer whose career ran from 1927 to 1971. Bob's first five years with The Stutz Motor Car in Indianapolis where he was the engineering supervisor in the development of power brakes. He worked on vehicles ranging from the famous Stutz Bearcat and later on tanks and amphibious Jeeps.



"He was in the thick of advances that happened during his career," said his son, John. "He helped develop and design many things that became standard parts of vehicles."

From 1932 to 1947 Bob became director of engineering at Marmon-Herrington which manufactured trucks, tanks, and buses. During this time, he was involved in the development of many prototype vehicles for the army, including airborne Locust Tanks, the first half-ton truck for foreign governments, the first amphibious Jeep, high-speed track-laying tractors, and many other units for the Marine Corps and Coast Guard. He finally became VP and director of the company.

From 1947 to 1961 he was executive engineer to the VP of the Diamond T. Motor Truck Co. of Chicago. From 1961 to 1967 he was director of engineering for the White Motor Co. in Lansing, Mich. Later after four more years as director of engineering research with the Brockway Motor Truck Co. in Cortland, N.Y., he retired.

Bob was an active member and officer with the Society of Automotive Engineers (SAE) since 1935. He was also a life member of Automobile Old Timers—autos of 1914 vintage. A loyal class-

mate, Bob enjoyed some of our reunions and took many photos.

We send our condolences to the widows and families of these classmates.—**Joseph C. Burley**, secretary, 1 Harbourside Dr., Delray Beach, FL 33483; **Lawrence B. Grew**, assistant secretary, 21 Yowago Ave., Branford, CT 06405

28

65th Reunion

By the time of this issue of the *Review* you will have had the first of three planned letters regarding our 65th Reunion, in September, and will soon receive the second in January. Plans appear to be well coordinated between the Alumni/ae Office and the capabilities and interests of our members and by June we can look forward to a worthwhile and enjoyable gathering of the remnants of '28 who have survived these many years of individual and group accomplishment. We hope that all, whether attending the reunion or not, will be in contact with those who can pass information on to the rest.

Further information has been received concerning the illustrious career of Adm. **Armand Malcolm Morgan** whose death was noted in the October *Review*. Armand joined our class to receive an MS in naval construction after graduation from the Naval Academy at Annapolis. As major accomplishments, he headed the design and construction of all submarines during World War II and of all Navy ships for many years after that war. After retirement he was involved in consulting work on industrial and military problems.

An additional death to report this month is that of **Homer Adron (Bunny) Burnell** who died on June 26, 1992. Our condolences to his family and friends.

Messages, including hopes to be at our 65th, have been received from **Henry (Hank) E. Lamb** and **Walter (Dick) E. Hildick**. **Alexander (Aleck) G. Tsongas** entered the current political arena in the early rounds working on the presidential campaign of Paul Tsongas. Their family relationship is not known.—**Ernest H. Knight**, secretary, Box 98, Raymond, ME 04071; **Hermon S. Swartz**, chairman, 12 Minola Rd., Lexington, MA 02173

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Please send news for this column to: **Karnig S. Dinjian**, secretary, P.O. Box 83, Arlington, MA 02174, (617) 643-8364; (603) 926-5363

30

Occasionally class notes yield an unexpected and gratifying dividend and this month we have such a dividend to report. In the July issue I included an item about **Harold Brown** based on information supplied by his daughter-in-law, Dorothy Swanton Brown—daughter of former '31 Secretary John Swanton, wife of James Brown, '59, and mother of Alice Brown, '86. Shortly after the July issue was published, I received a letter from Joel Pratt, '66, who, having read the item about Harold, wrote on behalf of his mother, Ruth Jagger Pratt, whom Harold dated during the late 1920s. I sent a copy of Joel's letter to Dorothy Brown and Harold's address to the Pratts. I understand the Pratt and Brown families have now exchanged several letters reminiscing about this 65-year-old romance and mutual friends and acquaintances of the 1920s.

The lead article in the March 1991 issue of the *Leisureville News*, a publication of the Palm Beach Leisureville Community Association of Boynton Beach, Fla., is a tribute to **Jim Torbit**. It appears that for the past 10 years Jim has been president of this association, which includes more than 1,800 homes and 500 apartments and has an annual budget of nearly \$2 million. The article describes in glowing terms Jim's impressive contributions, in particular

his reorganization of the association's financial operations and the landscaping improvements he introduced.

At the time of our 60th Reunion, I made a brief report on our oldest and youngest survivors. At that time **Mark Culbreath**, who was born in 1898, was the oldest. We now have a report that Mark died last April 12. He spent much of his career working as a civil engineer for Burnes & McDonnell Engineering Co. in Kansas City, Mo. He had a professional engineers' license in six states and Saskatchewan and was active in the American Waterworks Association, National Society of Professional Engineering, and the Water Pollution Control Federation. For three years he was president of the Kansas City MIT Alumni Association. He apparently had no children.

According to my records, which may well be in error, Mark was the last of our survivors to have been born in the last century. Upon his death, the mantle of seniority devolves on **Joe Kania**, who was born in 1901. Of our three "runners up," all born in the early part of 1903, we have brief comments from two: Ruth and **Irving Dow** have been living since 1988 in a life-care community in Mitchellville, Md. Irv says their health is generally good, but they have decided that air travel is too strenuous and they do not drive far from home. He is still on the community's Fiscal Review Committee and asks hard questions with which the management "is not always too happy." ... **Bill Harris**, another 89-year-old, is "getting along quite well." He walks a mile each day and spends half an hour on a rowing machine.

At this spring's meeting of the North Carolina Institute of Chemists at Duke University, **Win Hartford** received the Institute's Distinguished Chemist Award. ... **Angelo Ricciardelli** is "enjoying retirement, jogging and playing golf, spending two hours a week recording for the blind, and still taking university courses." —**Gordon K. Lister**, secretary, 294-B Heritage Village, Southbury, CT 06488

31

This is not a cheerful month. To start off with, we have the passing of **Howard Larsen Richardson** on May 1, 1992 at New Britain, Conn. Howie was a busy person, taking VI-A and trying to carry on school activities at the same time (he forgot to send in his memorandum and photo for *Technique*). He was on the field day freshman crew and later on the varsity crew (he had the T with crossed oars and the "T"), the Tech Boat Club, Psi Delta, Quadrangle Club, and still managed to make Tau Beta Pi, and was married on October 23, 1930 to Evelyn Defrate, who survives him.

After graduation, he went to work for Hygrade Sylvania in Salem as an engineer and stayed with it there and in New York—rising to be senior VP. Next at Stanley Works in New Britain, Conn., he went on to become executive VP in 1962. He then served as VP of General Dynamics for two years, then President of Silicon Transistor Corp. until 1972, then a director. He was also a director of Sybron Corp., Burndy Corp., Vitramon Corp., and Air Land Systems Corp. He also listed himself as a consultant in more recent years.

Howard had also been a member of Institute of Radio Engineers, Illuminating Engineering Society, Society for the Advancement of Management, New York Personnel Management Assn., American Management Association, and Academy of Political Science. He also served on the Board of Directors of the MIT Corporation.

Locally, in New Britain, he was a member of the Congregational-First Baptist Church, the Shuffle Meadow Country Club, and the Saturdays.

In addition to his wife of 62 years he is survived by a son, two daughters, a brother, 11 grandchildren, and 11 great-grandchildren.

In addition, he served as president of our class

for many years.

"The Duke" or "Eddie" as known in *Technique*, (**Edwin Joseph Ducayet**) died of a stroke at Fort Worth Hospital May 8, 1992. An aeronautical engineer, he was one of only three aeronautical engineers in our class of 29 aeronautical engineers who managed to get a job with an aeronautical firm. He joined the Curtis Aerospace Division of Curtis-Wright Corp. in Buffalo, N.Y., where he worked with such famous aircraft as P-6E, SOC-1, P-36, P-40 and C-46. After seven years in the engineering department, he moved to the sales and contracts department where he remained for seven years. During World War II he was contract manager for Curtis-Wright in Buffalo and later in Columbus, Ohio.

In 1950, he went to Bell Aircraft as VP in charge of the helicopter division. The following year he was in charge of the transfer of that division to Fort Worth. It became Bell Helicopter Corp. in January 1957, as a subsidiary of Bell Aircraft Corp., and he was named VP.

"The Duke" became the first president of Bell Helicopter Co. (as it was renamed after being reorganized as a Textron subsidiary) on July 2, 1960, and under his leadership it grew to the worldwide organization it is today. In January 1972, he was named chairman of the company and retired at the end of the year.

In addition, Eddie served as director of the First National Bank of Fort Worth, a director of Textron, and of Franklin Corp. and Camco in Houston, an oilfield services business.

He also served as a member of Texas Christian University Research Foundation, as president of the American Helicopter Society, and as a member of the Advisory Board of the Association of the United States Army. Other boards on which he served include: Aerospace Industries Association, National Aeronautics Association, Air Force Association, Army Aviation Association, American Ordnance Association, Navy League of the United States, and Fort Worth Airpower Council.

I don't know how he did it, but he was also a member of the Shady Oaks Country Club and River Crest Country Club—and must have spent some time on those courses.

He was survived by his wife of 54 years Elise L. Ducayet, a son, a daughter, a sister, and three grandchildren. The family suggested contributions be made to Cook-Fort Worth Children's Medical Center.

Our remembrances of these two gentlemen remain vivid in us, and we all give our regards to the families of both for we will all miss them. Few of us could have done as much good as they did in their lifetimes.—**Wyman P. Boynton**, secretary, 668 Middle St., Portsmouth, NH 03801, (603) 436-1309

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Our 60th Reunion is past and now part of our pleasant memories. We received many letters from attendees expressing their pleasure. To the 62 classmates who paid a voluntary class dues of \$25, **Tom Weston** sent a flashing MIT pin. **James Abbott** writes, "It is interesting to reflect that in 1932 the flashing pin would have taken a suitcase full of vacuum tubes." He regrets not coming mainly because his wife Rita is making a slow recovery from her knee surgery.

Bernard J. McMorro, who came from Honolulu with son and grandson, writes an appreciative letter. He enjoyed the memorabilia room, especially seeing himself (at age 23) in the class picture taken at the picnic on the island in the harbor. ... **Alan Crowell**, the treasurer of the MIT Club in S.W. Florida writes that many in the club were fond of **Jack Millman's** shell sculpturing and would like further information on Jack. ... **Frank R. Cook** thanks Tom Weston for the flashing pin. He writes that his wife is on her fourth working trip to Finland and Estonia, where she teaches English as a

In 1918, Walter H. James, MIT class of 1896...

- taught Mechanical Engineering at MIT
- bought his first car, a Model T Ford
- and wrote *Joys and Sorrows of an Automobilst*

In 1992, JOYS and SORROWS of an AUTOMOBILIST...

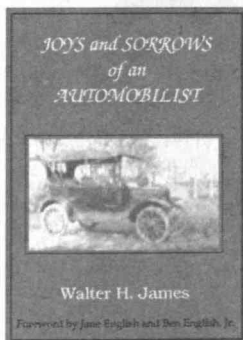
- was discovered in a New Hampshire attic
- and was published with his original photographs



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second language. Things are real tough over there, but the Estonians are survivors.

Doris Gilman thanks **John Brown** for inviting her to the reunion. She enjoyed very much meeting old friends and making new ones. . . . **Mrs. Ed McLaughlin** (Polly) writes the reunion was a great gathering, beautifully planned. Ed would write you himself, but the very next week after the reunion he was hustled off to the hospital with a bleeding ulcer. After four transfusions he feels better and has returned home.

Ben Chadwick thanks Tom for his electronic gadget. Ben just celebrated his 55th wedding anniversary. He took his five children, four grandchildren, and all their mates (18 in all) on a six-day boat ride on Lake Powell. Ben has had many medical problems recently. Now he faces the removal of a tumor on his right kidney. He of course hopes for the best but he says he has had all one could wish for, a good wife, fine children (all college graduates), and nine grandchildren. He has travelled all over the world including many out-of-the-way places.

Tom and Rose Weston took a 12-day cruise on the Mayan Prince of the American Canadian Caribbean Line where they had a good rest after the hectic but enjoyable 60th Reunion. The cruise took them past the Statue of Liberty, up the Hudson River, through the Erie and Oswego Canals, down the St. Lawrence Seaway, to Montreal and then Quebec. Tom writes this about his 4th of July. "We were moored by a park and celebrated with a bonfire, fireworks, etc. Almost 50 feet away was another bonfire and a group of Canadians, one playing a guitar. I sauntered over along with our own group and soon had all singing. We concluded with the Canadians singing 'O Canada,' our group 'The Star Spangled Banner,' and a finale with all singing 'Auld Lang Syne.' Our two groups are now cemented forever in true fellowship."

We should send Tom to all the trouble spots in the world to bring peace and good fellowship.

Jane and **Joseph Stowell** write Tom that they had a marvelous time at the reunion and that Tom did a great job keeping everything pepped up. . . . **Bennett Archambault** and **Cecil Boling** sent in their "Thank You" notes for Tom for the electronic gadget and reunion notes.

As you read this, we are entering our holiday season. On behalf of all the class officers, we wish all our classmates a Merry Christmas and a Happy, Healthy New Year.—**Melvin Castleman**, secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

33 60th Reunion

Now hear this. . . Save the dates, June 2-6, for our 60th Reunion. We will be staying at the Sheraton Tara in Danvers, Mass., and you can reserve your \$89 room by calling (508) 777-2500. More details will follow.

Our estimable president, **Dick Fossett**, noticed that **Madeline Lynch** passed away in 1986. No further information except that she is not related to **John I. Lynch**, 6 Curtis St., Winchester, MA 01890. After graduation from Course XV, John entered the boiler business developed by his grandfather in 1892, who passed it to his son, who passed it down to John, who passed it to his son, who sold it. But his son is still there and involved in drainage into the Bay (excuse me, Boston Harbor).

We are indebted to Sheldon Thorpe, '52, for information on the career of **Ernst W. Spannake**, who died April 30, 1992. Ernst had a highly varied and distinguished career as an engineering executive and inventor. He served as technical director of Barnes and Reinecke, Letourneau-Westinghouse, Raymond International, and Warner Electric, developing diesel-hydraulic applications and controls. He served for 12 years as corporate VP for engineering at White Consolidated Industries, directing development for appliances, textile machinery, chemical processing equipment, machine tools, and valves. He received 20 U.S. patents for his inventions and presented seven

technical papers at conferences.

After retiring from White Consolidated in 1981, he opened his engineering consulting firm, ESPA Development Co., and was actively engaged with new products and technical projects until the day of his death.

Classmates, I think you are among the elite. It's a helluva note when the only thing your secretary can report is the departure of your classmates.—**William B. Klee**, secretary, P.O. Box 7725, Hilton Head Island, SC 29938

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Please send news for this column to: **Robert Franklin**, secretary, Box 1147, Brewster, MA 02631; **George Bull**, assistant secretary, 4601 N. Park Ave., Chevy Chase, MD 20815

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Stanley M. Lane writes from his home in Helena, Mont., "I retired way back in 1978 after 43 years with Asano, Inc. I retired as a master polluter having managed a lead smelter for 20 years." He feels very fortunate to have retired in Montana where there's lots of space, scenery, golf, and fishing. . . . **James W. Libby** writes from Yorklyn, Del., that he and Helen had breakfast recently with **Nathalie and Thonet Dauphine** on the Bay, "site of many happy sailing years together with our families." They were on their way to a wedding in Chapel Hill. "Our appearances may change with the years but our senses of humor and outlook in life shows no difference over the 50-year span that we have known each other." The get-together missed by one day celebrating the Thonet's 54th wedding anniversary.

The Senior Open of the PGA was held this year at the Seacon Valley Country Club, home course of **John Brosnahan** where John served as a marshal on five of the seven days of the tournament. He said he had very little to do but stand for four or five hours each day as the spectators were very peaceful. They did annoy Lee Trevino so much for autographs that he skipped the third practice day, John reported.

Some interesting information concerning **Max Wasserman**, Course XVII, who died in January 1986. He was a founding member of the Council for the Arts at MIT, and a collector and advocate of contemporary visual art. The Max Wasserman Forum of Contemporary Art has been endowed in his memory and has a public forum each year.

Please keep your news coming, it may not seem like much to you, but your former classmates will be interested.—**Allan Q. Mowatt**, secretary, 715 N. Broadway, #257, Escondido, CA 92025

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Continuing in Rhode Island, **Tom Johnson** resides in Providence and a summer home in Little Compton, but I saw him at his "retirement" business in Fairhaven, Mass. From 1944 to 1978 he was with Federal Products Corp. in Providence, makers of mechanical and electronic indicators, the latter good to millionths of an inch. Since retiring as VP of R&D, he and subcontractors build custom 25' and 30' power boats—three or four per year. At Tom's shore house on a high bluff, five feet of the property dropped away in the violent storm last year, and he is having trouble getting clearance to build a sea wall. . . . **Karl Kelpke** moved to Tiverton years ago, but he is still deep in Sharon, Mass., history and genealogy. He was Course II SB and SM and retired as director of R&D at Kendall Co. and chairman of the Bank of Sharon. Karl's ancestor Estey was a founder of Sharon, and a g-g-great grandfather left an eight-year diary, kept daily until he was "too much in his cups." Using this

source and Karl's long knowledge of the area, he wrote a novel entitled *The Sting of the Adder*. He knew **Bill Hope** from Course II and sees him often, and recalled **Pat Patterson's** boarding with Bill's family in Weston while an undergraduate. Karl spoke warmly of **Laddie Reday** (deceased 1987).

Lee Tolman (Course IX) was in army service five years in World War II and continued on active service through Korea. Later as a civilian employee he spent eight years on aircraft weapon suspensions and ordnance. Retiring in 1971, he bought a 31' sloop in England, sailed the Channel, and took canals and rivers across France. Then, after three and a half years on the Mediterranean, the Spanish and French coasts, and back to England, they shipped the boat to the United States. Settled now in Portsmouth, R.I., he teaches boating safety for the Coast Guard and does beautiful wood carving. Wife, Dorothy, paints scenes of the Far East which decorate their home.

Avis and Ariel Thomas put me up overnight at their lovely home on a Coventry lake. They had lived in 17 homes in five states during his sanitary engineering career, but always had this summer house to come back for roots. He earned an MS at University of Illinois in 1938; returned to MIT as assistant professor after World War II (Army major). After a few years in U.S. Public Health Service, he joined Metcalf & Eddy for 30 years, winding up as senior VP when the partners incorporated. Al worked with **Bill Healy** on New Hampshire projects (see our tribute to Bill in April Notes), and recalled a seven-year responsibility designing and building a county sewage plant in New Jersey. Pressure from the county, which incurred a large debt but had no income from the many towns until operation, started the joint flows prematurely over the last eight miles to the interceptors. At 2 mph Al had four hours to get done and out of the way!

At one time, **Morris Lepes** (Course II) was in building construction and land development business in Tiverton, but my record was out of date. He moved to Sarasota, Fla., a few years ago, and I reached his wife, Anna, on the telephone. She told of his having developed a good part of Tiverton, and there is a street named for him. He was president of the Chamber of Commerce and of his temple in Fall River. They return to New England for summers in Plymouth.

A note from **Henry McGrath**: "The skiing in March at Whiteface Mountain north of Lake Placid (1982 Winter Olympics site) was hard to beat." OK for the east, Henry, but at Santa Fe we skied from the week before Thanksgiving until two weeks after Easter, on a base that grew to over 100 inches and finally disappeared about July 15. Come on out, everybody! The top of the lift is 12,000 feet, with the base lodge at 10,350, all just 35 minutes from my door and free if you are over 72. . . . A letter from **Gerry McMahon** tells of his moving from Lake Charles, La., to 8110 Birch Glen Lane, Houston, TX 77070-3603, June 16. "Five of our six children live in the Houston area and Catherine's sister and one of her brothers are also nearby. Sorry we weren't able to make the 55th Reunion. Between celebrating our 50th wedding anniversary and trying to sell the house we couldn't squeeze in the trip. Next time you head east, please stop for another visit." They expect to keep busy with ham radio, genealogy, Chemical Society, DAR, etc. at their new home, the first in 44 years.

Notes and letters put life into these Class Notes. Please, when you are writing your greetings to relatives and friends, send a note to Pat or me. We want especially to hear from classmates not shown in Notes for a long time. There are a hundred still, and it is unlikely that my visits can include you all in our remaining years. . . . President **Alice Kimball** reports good attendance at Technology Day events: the **Bordens**, **Petersons**, **Thomas**, **Bob Gillette**, **Florence Cooperstein**, **Martin Gilman**, **Herb Metten**, **Jack Zeitlow**, and **Ken Arnold**.—**Frank L. Phillips**, secretary, 1105 Calle Catalina, Santa Fe, NM 87501, (505) 988-2745; **James F. Patterson**, assistant secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4171

Congratulations to **Joe Keithley**! In September, Joe was inducted into the National Academy of Engineers! The academy, with 1,628 members, is the Hall of Fame for engineers. In an interview, Joe credited MIT (where he earned both bachelor's and master's degrees in engineering) for "opening up his world."

Paul Allen retired on February 28, 1982, from Cyprus Mines Corp., where he was executive VP. His main interests are trekking, mountain climbing, cross-country skiing, and travel in general. In January 1991, he climbed Mt. Vinson (16,000 ft.) in Antarctica. In April 1991, he spent two weeks in Spitsbergen skiing and camping on the glaciers. In August and September 1991, he spent three weeks on a nuclear-powered Russian icebreaker from Provednya in eastern Siberia to Murmansk. Following that trip, he traveled to Mexico, Johannesburg, Cape Town, Zurich, Stockholm, Vienna, Linz, Bristol, Paris, and Mulhouse. . . . **Richard Karch** retired June 29, 1991, from Pipelines, Thermos, Cornell University, and Ball State University. He lost his wife, Beatrice, in 1989. He makes his home in Mashpee, Mass.

Charles Kahn had planned to attend our 55th Reunion, but his wife, Catherine, suffered a stroke in March. He writes, "She was very lucky in that she is 100 percent physically, but her speech interpretation and translation from sound to comprehension have been damaged and she has to grope for words. With her one-hour, four-times-a-week therapy, she has made excellent progress. I'm doing okay, but practically stopped playing golf in favor of boating and fishing. Have been involved in the local power squadron (sail and power) to the point of celestial navigation! Thank the Lord for Loran!" . . . **Dave Tuttle** retired from Stanford University in 1979 and he and his wife, Becky, are living in Stanford, Calif.

Walt Wojtzak retired as senior VP of Standard Builders, Inc., in 1985. Walt wrote, "We enjoyed the reunion but were disappointed by the absence of so

many classmates who should have been there. Wish we could find out what the problem is." The committee would also be interested—any suggestions? Walt is president of the MIT Club of Southwest Florida. Last January President Charles Vest was a guest of the club and Chair of the Corporation Paul Gray, '54, and Mrs. Gray will be guests this coming January.

Jim Ewell retired in 1979 as senior VP and director of Procter & Gamble Co. Jim is a member of the Board of the Cincinnati Children's Hospital and of the Cincinnati Symphony Orchestra. He writes, "Just returned from cruise through the Norwegian Fjords and up to the North Cape. Through the Panama Canal last January. Sorry could not make the reunion, but hope to attend the next big one."

It is with sorrow I report the deaths of two classmates: **Herbert P. Gusdane** on December 1, 1991 (his wife, Mary, wrote that Herb had planned to attend our reunion), and **Frank D. Lewis** on April 10, 1992. Frank leaves his wife, Beatrice, a daughter, and two sons. We extend our condolences to the Gusdane and Lewis families. —**Robert H. Thorson**, secretary, 66 Swan Rd., Winchester, MA 01890; **Leonard Seder**, assistant secretary, 1010 Waltham St., 342-B, Lexington, MA 02173

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55th Reunion

Those of you who knew **Haskell Gordon** will remember the class notes a year ago when his mini-biography was more concerned with his activities in the Boston Symphony and its summer home at Tanglewood than with his successful career as a department store executive. Martha and **Jan Jansen** have just returned from their annual safari to Tanglewood with the report that Haskell is not forgotten: A special area there will be dedicated to his memory, his and Ina's fellowship for resident artists will be continued, and Ina will remain a member of the BSO board of overseers.

F. William Brown died May 15. Bill was one of those fortunate people who spent his entire career doing what he wanted to do. After graduating in Course VIII, he spent 14 years as a physicist in the Navy and the rest of his career as a physicist in various civil service positions: after retiring, he became a physics tutor. Except for an abiding interest in opera and ballet, physics was his life.

Richard H. Koehrmann died May 3. After graduating from Course X, Dick spent his entire career in the shoe industry, half with International Shoe (becoming technical director of the elastomers division) and half with Sears Roebuck, retiring as group manager of organic materials. He was a worldwide traveler and international consultant on shoe manufacture; he bears primary responsibility for raising the quality of Taiwanese footwear from cheap sandals to top-grade women's dress shoes.

On the lighter side, we have no news. Your secretary is goofing off at his summer place in New Hampshire, and his assistant, having resisted a simultaneous invasion of five Norwegians, two Dutchmen, and a Turk, is preparing for a week in Jamaica with a coterie of 32 descendants and spouses. —**Don Severance**, secretary, 39 Hampshire Rd., Wellesley, MA 02181; **Ed Hadley**, assistant secretary, 50 Spofford Rd., Boxford, MA 01921

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Fred Grant, chair of the Class of 1939 55th Reunion Committee, and **George Beesley**, **Manning Morrill**, and **Paul Stanton** made preliminary arrangements for the time and place. Class celebrations are to start on Tuesday, May 31, 1994, at the Hotel Viking in Newport, R.I. Return to Cambridge will be after lunch on Thursday, June 2, in time for supper and Tech Night at Pops. End of our 55th is to be after Tech Day, Friday, June 3, probably after the alumni lunch for most '39ers. Fred expects to have a full committee lined up by March/April

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Mark Peters '87
West Palm Beach, FL

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1993, after which details about timing, costs, etc., will be announced. MIT Class of 1937 just celebrated its 55th Reunion at the Hotel Viking and was pleased.

Bill Wingard was reported by Anita to be recovering nicely after by-pass heart surgery during late July. Bill's doctors agreed it would help his post-op exercising if he were to open a lot of get-well messages addressed to Apt. 505, 717 Maiden Choice Lane, Catonsville, MD 21228.

Bob Withington and **Dick Loesch** were mentioned often and favorably in a new 475-page book titled *Legend and Legacy* by Robert J. Serling, about Boeing's history for 75 years. Bob retired as VP-Engineering of the Boeing Commercial Co., and his many mentions throughout the book recite his involvements with all aircraft designed, both military and commercial. Bob completed installation of his rebuilt engine in his Cessna, and he and Betsy are enjoying flights around the northwest. . . . Dick Loesch's career included piloting many Boeing aircraft during their first test flights. In the book are references to mid-air thrills that were Mother Nature's immediate responses to pioneers who volunteered for test flying. The book is great reading, and I consider it a tribute to all of our classmates who made their careers in aviation and aerospace.

Hans Bebie and **Austie** report closed season on Dungeness crabs in the saltwater near their lovely summer home on Hood Canal. They wedged in a trip to Costa Rica before returning to engineer and install an electrically operated hoist for their crabbing boat. Hans said the hoist is to lift the boat, not to lift crab traps into the boat. More on this after enjoying some more of Austie's delicious chowder.

Bob Schmucker writes: "...noticed that you had a new pacemaker. A few years ago I was working on improving magnets to be used to charge the pacemakers...." Thanks, Bob, for your good work. My pacemaker works fine and we hope you are enjoying retirement at 5 Atherton Lane, Amherst, NH 03031. . . . **George Cremer** also deserves thanks from those who carry pacemakers, because about 10 years ago George consulted with General Electric about use of lithium in pacemakers. The good news is that a pacemaker is about the size of a half-dollar. The bad news is that's not what a pacemaker costs.

John Alexander and **Nancy** were cruising again, but this time it was around the Aegean Sea on a passenger liner. . . . **Will Jamison** continues consulting on fire prevention from Murray, Pa., and reports his golf score needs a bit of improving.

Wiley Corl and **Winona**, **Roy Haworth**, **Bill Murphy** and **Anne**, **Irve Peskoe** and **Bea**, **Paul Stanton** and **Dora**, and **Bob Touzalin** and **Aletta** will attend the January 4-7, 1993, MIT mini-reunion at Naples, Fla. Norm Klivens, '40, is chair for the three-class event and his pitch was: "...We survived the Depression, Tech (when it was really tough), the War, marriage, parenthood, and even the aging process. Let's celebrate!..." About 100 have made firm reservations and about 40 more say maybe. Paul Gray and Priscilla will attend. Bob Touzalin and Aletta invite pewter buffs to their home to see their collection.

From the *Patriot Ledger*, Quincy, Mass.: "...**William S. Quigley, Jr.**, of Scituate, 76, a former Navy supervisor of shipbuilding at the Fore River Shipyard in Quincy, died Saturday in Brigham and Women's Hospital, Boston.

"A native of Charlestown, he attended MIT and received a mechanical engineering degree from Carnegie Tech in Pittsburgh. He received a master's degree in business from Northeastern University.

"Mr. Quigley worked for the Employers Insurance Co., Boston, now Commercial Union Co., and in the planning and business department of the Lahey Clinic.

"Mr. Quigley was a Navy veteran of World War II, serving with the Seventh Fleet in the North Atlantic and South Pacific."

Alice Kimball, '36, relayed this report from the *Hartford Courant*: "...**Donald Berdette Peck**, 74, of Bloomfield, Conn., died July 1 at Mount Sinai Hospital. He graduated from MIT with a bachelor's degree in chemical engineering and was chief chemist at

Fuller Brush Co., Hartford, until retiring in 1968."

We are saddened by a report of the death, on June 28, 1992, at Cagayan de Oro City, the Philippines, of **Leo W. Welch**, Course XVI. There were no details.—**Hal Seykota**, secretary, 2853 Claremont Dr., Tacoma, WA 98407

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Leo Pach of Del Mar, Calif., telephoned with his current address and a request for the whereabouts of two MIT alums. With the help of **Ed Bernard**, I was able to send the information to him. Ed is getting along reasonably well now, still recovering from major surgery.

Class President **Norm Klivans** sent me a copy of the letter he mailed to the 41 alumni/ae who have made definite reservations and the 20 additional who may attend the mini reunion in Naples, Fla., next January. MIT Chairman Paul Gray, '54 and his wife, Priscilla, will be guests of the group for one evening. A full program is planned, with lots of interesting things to do.

George E.B. Hill passed away in Kentfield, Calif., on May 7, 1992. George received a degree in architecture from MIT after graduating from Harvard in 1933. He worked for many years as an architectural designer. He was a pairs Olympic figure skater in 1936 and North American and U.S. National Champion.

Send your news or call **Richard E. Gladstone**, secretary, 1208 Greendale Ave., Needham, MA 02192, (617) 449-2421

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Jane Johnson writes that her husband, **Hamilton Johnson**, died of complications caused by Parkinson's disease, on June 16, 1992. He is also survived by a son, four daughters, and four grandchildren. She adds that "his son, and two sons-in-law are MIT graduates, which must be some kind of a record."

Ham's passing comes as a shock following his upbeat submission to our 50th Reunion Yearbook. His classmates may also be interested in gleanings from the yearbook and other MIT publications to supplement the sad news. In his own words: "A goodly chunk of time was spent as a plant manager in a corrugated box plant, plus more years in various staff positions. Other endeavors included owning and operating a screw machine and automotive chrome plating plant. Real estate trading and building housing units turned out to be a profitable avocation." Golf, traveling, skiing, and sailing/racing on the Great Lakes were listed as hobbies.

Our 1941 Yearbook tells us that Ham graduated in Course IX, was an IFC member of Phi Kappa Sig, and participated in *Voo Doo*, *Technique*, the Army Ordinance and Nautical Associations, and both our Field Day Tug-of Wars. After graduation he was a lieutenant (j.g.) in the U.S. Navy from July 1944 to April 1946.

Notice of the earlier passing of another classmate was forwarded by the Alumni/ae Association. **Charles Margnetti**, a retired senior chemist for the New England Nuclear Chemical Co., died of cancer June 9, 1986. He had worked at the New England Nuclear's Division of Labeled Chemicals for 20 years and retired in 1980. He leaves his wife, Elvira, of West Roxbury, Mass., two stepsons, and many nieces and nephews.

We express sympathy from the class to the families of our departed classmates.

Sepp Dietzgen warned that there would be issues with no good news to report and to postpone a few items each month. Counting on you all and not wanting to increase the three-months lead time further, I didn't take his advice. Help! I'll be forced to invent some items! I understand similar threats have increased the output of real news from other classes.—**Charles H. King, Jr.**, secretary, 7509 Seabago Rd., Bethesda, MD 20817, (301) 229-4459

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Bob Rines will have more time to hunt for the Loch Ness monster now that he has retired as president of the Franklin Pierce Law Center, which he founded in 1973. . . . **Steve Stephanou** writes that he is "fully retired," has finished writing the last of four books, titled, *The Manufacturing Challenge—From Concept to Production*, and has been fishing in the Feather River in California and at Stuart Island in British Columbia. Steve caught some huge, up to 25-pound salmon. So if you're looking for a successful fishing guide, Steve is your man!

Mary, wife of **Martin Lindenburg**, enjoyed meeting with Lenore and **Bob Bloom** at our 50th Reunion. Mary and Lenore found that they were both Phi Beta Kappa graduates of Hunter College, but were four years apart. Mary is a regular solver of the math problems in *Technology Review*. . . . **Ted Judd** was helping the defense in a law suite against the company he'd worked at for 38 years and was so successful that the opposing counsel referred to him as "Judd for the Defense." Maybe he has the start of a new TV series there.

Douglas J. Forsyth, assistant professor of history at MIT, has been named Class of 1942 Career Development Professor. We already "have" our other Class of 1942 Professor—**Robert J. Sibley** of the Chemistry Department. . . . One obit: **John Hinchman** of Course II died in May in West Cornwall, Conn. After service in the Engineers in World War II, he founded Hinchman Manufacturing Co. in Roselle, N.J. After retirement he did antique-clock restoration, was a member of his church choir, and sang bass with the Kent Singers. Our condolences to his daughters, Molly and Joan.—**Ken Rosett**, secretary, 281 Martling Ave., Tarrytown, NY 10591

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50th Reunion

Please send news for this column to: **Bob Rorschach**, secretary, 2544 S. Norfolk, Tulsa, OK 74114

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Walt Turner tells us that he is enjoying retirement after a long and rewarding career as professor of electrical engineering at the University of Maine. He is keeping busy with travel, gardening, and volunteer work and is looking forward to the 1994 reunion. There are several '44ers in Maine and Walt suggests that you all try to attend the next meeting of the MIT Club of Maine. . . . **Stan Holbrook** writes that he retired in 1984 after a career in development engineering and marketing at the Cryovac Division of W.R. Grace & Co. He is now pursuing genealogical research as a member of the National Board of the Mayflower Descendants Society and governor of its South Carolina unit. He and his wife, Marjorie, are ardent photographers and birders and enjoy travelling throughout North America in their trailer.

We just learned that **John Burdakin** was inducted into the Michigan Transportation Hall of Honor in May 1992. John is retired president of the Detroit-based Grand Trunk Western Railroad. During his terms as a director of the Association of American Railroads and as chairman of the Michigan Railroads Association, he campaigned throughout the industry for high standards of rail maintenance and safety. These standards were exemplified at Grand Trunk, which became known as the "Good Track Road." John's citation was "for spearheading efforts to strengthen Michigan's railroad system in the 1970s and 1980s and for arranging the merger of three interstate lines while preserving control of them within Michigan." Congratulations, John.

We note with deep regret the passing of **Roger D. Smith** in March 1992. He was a member of Sigma Alpha Epsilon and served as an officer in the Signal

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Corps in the Pacific in World War II and also served in the Korean War. After graduation, he earned his law degree at Yale and for many years he was a partner in the firm of Jackson and Nash in New York where he was of counsel at the time of his death. Earlier he had been a chemical engineer at the Gates Rubber Company in Denver, Colo. Roger was a past president of the board of the Professional Children's School and a member of the Society of Colonial Wars. We extend our sympathy to his wife, Kathleen, and his three children, Silas, Jocelyn, and Luke.—Co-secretaries: **Andrew Corry**, P.O. Box 310, West Hyannisport, MA 02672; **Louis Demarkles**, 77 Circuit Ave., Hyannis, MA 02601

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Please send news for this column to: **Clinton H. Springer**, secretary, Box 288, New Castle, NH 03854

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Well, here it is Turkey Time and the remaining end of 1992, and we're here looking at the beginning of football mania, and our leaves here in Denver haven't begun to turn. It hardly seems possible. The most recent *billet doux* ("sweet letter") came in June from **Charles Wellard** who was kind enough to fill us in from his abodes in Pinehurst, N.C., during summer and Holmes Beach, Fla., in winter through spring. I look at his picture in our Year Book and seem to recall him being a V-12er who played basketball or lacrosse, or Field Day. What ever it was, Charles was always busy. Even in his semi-retirement he still serves on a half dozen corporate boards—and chairs two of them! In "spare time" Charles and wife, Jane, travel internationally several times a year, having interests in both Europe and Asia. When he's at his Florida home he engages in his sports fishing hobby. He mentions exchanging notes with his old "frat bro" and roommate, "**Bud**" (**Fulton**) **Brylawski**, a brother Vler. Maybe Bud could drop us a line. Charles sends his best regards to us all, especially his basketball and lacrosse teams! He also sends regrets for our deceased classmates, one of whom died this past May 2—**Walter J. Loughlin**, one of our electrical engineers with a master's degree.

Russ Dostal, one of our long-running class secretaries, from Cleveland, Ohio, sent a nice long letter at the end of July that brings his activities up to date. After a triple by-pass we mentioned a while back, Russ eventually joined a fine Wisconsin company in 1985. Russ attended the 45th Reunion last October "and was surprised to learn of how many other classmates are still working." He still works to pay for vacations in California, Hawaii, and Florida. He and wife, Mary, hope to visit the British Isles next year. Russ was disappointed with the turnout of the class at the 45th Reunion and hopes we will urge the Class to attend the 50th, wherever it may be—**BE THERE!**

As this "goes to press" in my computer cubby-hole, I just received a letter from **Jim Chabot** who was relaying it to my old roomy, **Stan Young**, (because he didn't have Stan's address). I shall fill you in on in the next issue in January. **YOU'LL HAVE A "COOL YULE!"**—**Jim Ray**, secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

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Forty-fifth Reunion notes (continued)... **Steve Dieckmann** retired six years ago from Hercules in Wilmington, Del. (20 miles from my old hometown of Elkton, Md.). Since then, he's been taking classes in art, French and German literature, and sculpture. In his spare time, he ice-skates and plays golf and tennis! Steve and Margaret have three children—one son is an MIT graduate and works for

Arthur D. Little in Boston, a daughter and her husband are entertainers in Las Vegas, and the second son works for a service station equipment contractor in Washington, D.C. There are five grandchildren... **John Ebersberger** retired in 1979 from Western Electric in New York City. Since then, he's been working for New York State Public Service as inspector of utility equipment—electric meters, water meters, gas lines, etc.

Fred Ehrich has had a distinguished career with General Electric (see our April 1992 column). He and Joan have three children, all with interesting careers. Their oldest daughter is an artist and art teacher who recently moved from New York City to Kansas City to be with her "almost fiancé." Their son and his wife are both doctors at Stanford Research Hospital. They have the family's only grandchild so far, who is almost 2. Their youngest daughter was married in October 1991. She's studying for a PhD in engineering at the University of Maryland and her husband is pursuing doctoral studies in economics at George Washington University.

Abbot Fletcher gave us a fascinating slide show of his trip up the west coast of Greenland on the sloop *Reindeer*. (This trip was reported in detail in our February / March column)... **Lorelei** and **Hugh Flomenhaft** are spending September in Spain—he promises to write later and tell us about the trip... **Alex Giltinan** had a distribution business in appliances and floor coverings until he retired in 1987. He and Martha live in Charleston, W.V... **Ginny Grammer** is currently working on an historical book but is not yet ready to tell us the subject. She does say that working on the book is more absorbing than going back to teaching! Ginny has six grandchildren; the oldest just graduated from Wellesley—Phi Beta Kappa and summa cum laude.

Ted Hogg was an engineer at Caterpillar until he retired six years ago. He lives in Aurora, Ill., and keeps in shape bicycling, cross-country skiing, etc. His son is married and has two children in Des Moines. His daughter is unmarried and lives with Ted... **Ed Kane** is technically retired, but he works two to three days a week as an OSHA consultant with insurance companies and also has been involved in Hartford Steam Boiler's program for environmental inspection and preventive maintenance. The rest of the time he likes to play golf with his wife—in West Hartford, Conn.

Ken Marshall is still involved with the Senior Olympics but trying to spend most of his time on the golf course with Lois. They have a married daughter with two children nearby in St. Louis. They also have two sons—one just married and the other about to be. So Ken and Lois are hoping for more grandchildren!... **Dick Mooney** was a manufacturer's rep involved in chemical sales and also owned a health food store until about five years ago. Then he and Mary moved to their farm in Staunton, Va. They have 400 acres, raise cattle and sheep, and love the area.

Alex Pastuhov was our reunion chair and did a superb job. Alex was president of the U.S. subsidiary of a French shipping company, Gas Ocean, when he left in 1978 to start his own consulting business. AVP focused on the natural and LP gas industry in all areas of management except exploration. Two years ago Alex started another company, Northeast Energy Storage. His objective was to build a regional liquefied natural gas storage facility in New England to make gas available locally during periods of peak demand when the demand might exceed pipeline supply capability. Such a facility would also allow a dual-fuel electric utility to store the gas already purchased and make it immediately available when needed. Alex and Adele have two sons and a daughter. Phil (the oldest) is a cinematographer who has filmed many of the stunt sequences in the James Bond films. (That's almost as dangerous as doing the stunts!) Stefan works in Maine as a house renovator, and Nina is in Florida doing telemarketing. There are five grandchildren—from newly born twins to age 9.

Bob Rediker just attended his retirement dinner after 40 years with MIT. He worked at Lincoln Labs

and as a professor in electrical engineering, both for the last 15 years. Bob is a member of the National Academy of Engineering. He and Barbara have two sons and five grandchildren. The older son is involved with computer software for schools. The younger graduated from MIT in 1977 and then switched to medicine—he's a cardiologist in California. Now that Bob is retired from the academic world, he keeps busy working on medical laser technology for a commercial company. . . . **Al Richardson** attended our reunion but without Phyllis, who was attending her own class reunion at Regis. Al started his own business in 1961 making vibration dampers for overhead powerlines and tall TV towers. He and Phyllis have four sons—no grandchildren. Al was on the golf team when he was at MIT, but today he tells us his handicap is a sad 11! (Sorry, Al, that wouldn't make the golf team anywhere—although it's a lot better than mine!)

Other news. Several newspapers have reported **Hank Rowan's** record-breaking gift to Glassboro State College in New Jersey—\$100 million to establish an engineering school. According to news reports, that is the largest gift to a public institution in history. Hank calls MIT "the greatest engineering school in the world," but says "building an engineering school from scratch is much more exciting." Glassboro is expected to be re-named in Hank's honor. Hank founded Inductotherm Industries (manufacturer of electric furnaces) in "his backyard" in 1954; the company's current sales were reported as \$468 million in a recent *Wall Street Journal* article. Hank also is a world-class sailor; he competed in this year's U.S. Olympic trials in the Star Class.

One death notice this month—**James Haggett** died in May. Jim was an industrial engineer with Norton Co., Worcester, Mass., for more than 30 years until he retired in 1981. After that, he worked as a consultant. He is survived by his wife, Gina, two daughters, a brother, and two grandchildren.—**R.E. (Bob) McBride**, secretary, 1511 E. Northcrest Dr., Highlands Ranch, CO 80126

48 45th Reunion

Ken Brock is up to his eyeballs in a project to develop a Regional Transfer Station for trash in Truro, Mass.. The station would also serve Provincetown. His wife, Ann, is involved with a planning group for the local library. Their first grandchild is Theodore Brock Alexander, born in January 1992. . . . **Ed Hanley's** last official day in business came after 42.5 years of work. He operated a kitchen supply and remodeling business in Denver. He couldn't find a replacement, so he is scaling down and is looking forward to having more time. For years, Ed was an educational counselor and he interviewed many students from the Denver area who were interested in attending MIT. The Educational Council has recognized him for his service.

Mark Wrighton, MIT provost, appointed Jacqueline Hewitt to the Class of 1948 Career Development Professorship. Her three-year term began in October 1992. Hewitt is an assistant professor of physics doing research using the techniques of radio interferometry. She and her students are concentrating in three areas: using high resolution imaging to study gravitational lenses, developing techniques of very long baseline interferometry in a search for planetary companions to stars other than our sun, and developing techniques to detect radio transients of astrophysical origin. The last project, a problem in distinguishing natural radio signals from the overwhelming man-made background of interference, is probably the best example of why one does research at MIT.

Professor Hewitt explains, "The project is in its early stages, but already my group has been brainstorming possible detection schemes, carrying out microwave measurements from the roof, and planning for a prototype detector to be built at MIT. The scientific skills and interests of the students provide a wonderful pool of creative ideas, and their energy and technical fearlessness give any project

extra momentum." Professor Hewitt appreciates the unrestricted financial support, which is extremely valuable in allowing for the testing and early development of these new ideas.

After receiving a BS from Bryn Mawr College, an exciting experience at Arecibo Observatory in Puerto Rico led her to graduate school at MIT and then a postdoc at MIT before joining the faculty. We hope that she will spend some time with our class next June at our 45th Reunion.

Bill Katz is active as ever as senior VP of Ionics in Watertown, Mass. The company is now over 40 years old and Bill has had key roles in both technical and sales areas from the beginning. Recently they built and are now operating a desalting plant for Santa Barbara, Calif. Water from the Pacific Ocean is desalted for use in that city. Revenues may be low now because rains have replenished reservoirs, but in the long run the company will profit from the traditional water shortages that had plagued the city.

As usual on this kind of project, Bill's role included sales, site development, installation, and start-up. He is a very busy executive. In prior years, Bill had been involved in hundreds of smaller desalting plants in the Middle East. During the Persian Gulf War, they were a major provider of fresh water to the troops. Currently, they are completing another plant for Pacific Gas and Electric in Diablo Canyon.

Ionics continues to be the leader in membrane technologies that separate and remove the undesired ions from the water supply. Whenever we meet, Bill talks of his dream of returning to composing music as he did for the Tech Show in 1948.

Peter Bolan has had an active second career after retiring from United Technologies Power Systems in 1982. He is currently acting director of the Soldier Science Directorate operated by the U.S. Army in Natick, Mass. He has been with the Army for 10 years and for the first four years he was at Fort Belvoir. He and his wife, Ruth, live in Granby, Conn. Their three children have added five grandchildren to the family. . . . **Paul Anderson** is keeping busy during retirement doing probate accounting for a private trustee in Salem, Mass., while continuing to play golf. . . . **Isaac Horowitz** was awarded the Oldenburger Medal by ASME. Isaac was selected "for outstanding leadership and contributions in the design of feedback control systems having significant parametric and non-parametric uncertainty, for conceiving and developing the quantitative feedback theory design method, and for exemplary leadership in feedback control education." Isaac lives in Davis, Calif.

Jim Hourihan has been a selectman in Marblehead, Mass., for the past five years. He is a candidate for reelection. Jim has served on Marblehead's Finance Committee for an additional 15 years. . . . **Vic Pomper** died from injuries that he suffered in an automobile accident. He and his wife, Anne, had been living in Weare, N.H., for the past seven years. On behalf of our classmates I extend our sympathy to Vic's wife, Anne, and her family.—**Marty Billett**, secretary and president, 16 Greenwood Ave., Barrington, RI 02806 (401) 245-8963

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Davis E. Wilson writes that he has been retired for two years from his job as a staff engineer at the Lockheed Missiles & Space Co. in Linthicum, Md. In his leisure time, he collects and restores old radios—Atwater-Kent for example.

Some of our classmates appear in the news with regularity and, once again, **George Hatsopoulos** takes a bow, this time for his election to the MIT Corporation Board of Trustees. George was a member of the mechanical engineering faculty from 1956 to 1962 and remained as a senior lecturer until 1990. In 1956, he founded Thermo Electron Corp. whose principal businesses include manufacturing of environmental and analytical instruments, alternative energy power plants and pre-packaged cogeneration systems, industrial process and power equipment, and biomedical products.

A questionnaire sent to **James C. Buck** by the Sloan Fellows Program Office was returned by his wife, Dorothy, who reported that he died August 25, 1990. I regret the lack of any further information. The class extends its deepest sympathy to family and friends.—**Fletcher Eaton**, secretary, 42 Perry Dr., Needham, MA 02192, (617) 449-1614

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Please send news for this column to: **John T. McKenna**, secretary, 182 Midpine Rd., P.O. Box 376, Cummaquid, MA 02637

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At the Aluminum Casting Research Laboratory's spring symposium on solidification modeling held at the Worcester Polytechnic Institute, an award named for our classmate, Professor **Merton C. Flemings**, was presented to Robert Spear. The award, first presented last year, honors contributions to aluminum casting technology.

Managing the Contract Administration of the Engineering Division of the Department of Public Works of Jacksonville, Fla., **George C. Groves** has an interesting avocation. He is the producer, director, and musical accompanist of the Morocco Temple's production of "Showboat Follies," a musical variety show with numbers from Gay '90s to the present day.

Your secretary, **Marty Greenfield**, was the proud father of the bride when his daughter Judy became the wife of William Baker on September 5, 1992. Judy, financial officer of Epidemiology of New England, is the youngest of his three daughters. All of Marty's children are now very happily wed.—**Martin N. Greenfield**, secretary, 25 Darrell Dr., Randolph, MA 02368



Howard Simmons, '51, was one of 15 scientists and inventors awarded the National Medal of Science by President Bush in 1992. Simmons, senior science advisor at Du Pont Co. and former head of basic research there, was cited for his "fundamental contributions to the knowledge of organic chemistry, and for his productive management of the premier industrial chemical research program in the U.S."

Clifford Sayre, who recently retired as DuPont's VP for logistics, is now a consultant in transportation matters for Mercer Management Consulting. Cliff has been very good about sending news for class notes, but I find from the press article from which I draw this information that he has been becomingly reticent about the professional awards he has received over the years, and his leading role in the field of transportation management. (Actually, class secretaries do not find a classmate's reticence becoming at all.)

James Stockwell has also retired, apparently with less equivocation than Cliff, as a partner and director of Heidrick and Struggles, an executive search firm, where he worked for 18 years. Previously he had been an entrepreneur in the field of electronics. He says he serves on a bank's board with **Chuck Ehlers**. Jim and his wife were looking forward to celebrating their 40th wedding anniversary last June with their five children and their spouses, and their three grandchildren.

Last June was also the 40th anniversary of Jim's and our graduation, and the reunion celebrating that event is still vivid in my mind. Among those attending were **Dana Mayo**, **Jim Davidson**, and **Swraj Paul**, who traveled here from his home in the U.K. Swraj was awarded an honorary degree of doctor of science in economics by the University of Hull last summer. The citation noted that he started a business with 5,000 pounds of borrowed money in 1968, and built it into an international steel business making pipe and other products. His business interests include growing tea as well as making steel. In addition, he is an active philanthropist. Among his benefactions the reader may remember his gift of scholarships to MIT for Indian students.

Dana Mayo was going to give courses in infrared spectroscopy to industrial chemists in

Hungary and Sweden. He notes reminiscently that his daughter attending Boston University Medical School lives just a short distance from his old Theta Chi frat house. Jim Davidson is planning to move to Swarthmore next year after living 29 years in Larchmont. He says he has a golf club lined up where he and Marcelle can continue with their favorite pastime. Jim still consults occasionally, too. I had not seen Jim for 40 years, but I had no trouble recognizing him—the second time I saw him. I maintain the first time did not count because he popped up in front of me wearing a hat. Generally speaking, the changes time brings did not seem to interfere with my recognition of others, or their recognition of me. **Art Turner** did mention that after looking at the picture I submitted to the reunion book, he wondered if he would know me if he passed me in the street. After reexamining the photo, I can't see why he would want to; I look deranged.

I was embarrassed not to recognize **Len Polaner** when I first ran into him. It was not his appearance as a distinguished business executive that threw me off, I think, but that he was not wearing black horn-rimmed glasses, or any glasses at all, for that matter. Len made a valuable suggestion for what I could write about in Class Notes when there was nothing to write about. I didn't tell him how many times I had, in desperation, been tempted to use a trip past the jelly section of a grocery store as an excuse for an item mentioning him. Len runs the family-named business that packs jellies, preserves, and other food items.

If appearances may have changed somewhat, voices seem to have changed much less. It was with real delight that I heard voices, complete in accent, phrasing, mannerisms, and choice of words, still familiar after so many years. I must suppose that mine has not changed much, either, a thought I find less delightful.—**Richard F. Lacey**, secretary, 2340 Cowper St., Palo Alto, CA 94301

Only six months until the reunion. I hope you all have put it on your calendar. I'm getting letters from various classmates who are planning to attend so I'll get right to the news.

I got a nice letter from **Allan Hoffman** who is a professor of bioengineering and chemical engineering at the University of Washington where he has



Allan S. Hoffman

been for the last 22 years. He sent along a couple of announcements that summarized how he has been doing. Some of his colleagues organized a symposium in honor of his 60th birthday in Daui, Hawaii, in December 1992 on the subject of "Future Perspectives of Biomedical Polymers." In addition, another colleague, **Stuart Cooper**, editor of the *Journal of Biomaterials Science*, Polymer Edition, organized a festschrift to honor Allan's birthday. As of February 1992, more than 60 manuscripts had been submitted and were expected to occupy at least four issues of the journal.

Allan also indicated that he had been selected as a "Founding Father" of the recently established American Institute of Medical and Biological Engineering. Allan enclosed a photograph of himself. I'd say he doesn't look much older than I remember him from almost 40 years ago. I hope he can tell me where he found that fountain of youth.

Joe Cahn sent me a copy of his family newsletter with a couple of comments appended noting that he was planning on attending the reunion. He lives

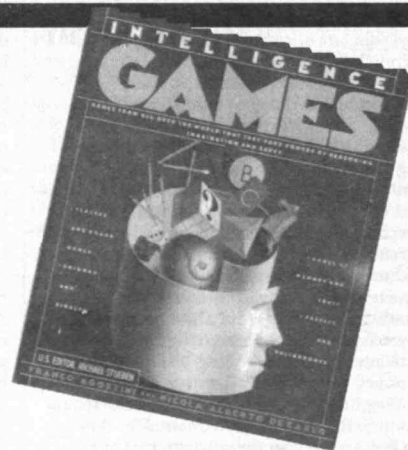
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in Santa Monica, Calif., in a beach front townhouse. The view he described makes my mouth water. Joe is a business litigator with an 87 lawyer firm in Century City. His oldest son, Davis, is the culinary manager of a 150+ unit supermarket chain in southern California. Daughter Sharon works as an independent certified shorthand reporter. Hilary is a fourth-grade teacher in the Redondo Beach School district. Son Bruce graduated from Loyola Law School in June 1990 and is now a first-year associate at the Los Angeles office of a national law firm headquartered in Chicago. If I counted right, Joe has four grandchildren.

I also got a long letter from **Joe Mullen**. Joe is still wandering around the world. He recently returned from a business trip to China; Kunming, Chuxiong, Bao Shan, and the villages and towns in between. He has been helping the People's Republic of China develop systems to use Eucalyptus wood as a fuel to supply power to the outlying areas during the dry season. This must be accomplished while maintaining a policy of reforestation to prevent erosion, and protect the environment against the ravages of wind, rain, and CO₂.

Joe, even if he is the oldest man in the class, has continued to remain quite active. He is commuting between Hawaii and Florida. He submitted a proposal to the Hawaiian Electric Co. to rebuild their large plant on Oahu. If he gets the contract, he will move back into an apartment he has there. In the meantime, he has lived in Motterrey, Calif., and more recently Fort Lauderdale, Fla., and is now contemplating a return to California. He keeps active swimming, golfing, walking, and spending time at the typewriter. He has three daughters, one in Texas, one in Connecticut, and one in Salinas, Calif., and seven grandchildren. Joe is looking forward to the reunion. I'm always glad to see Joe at the reunions. I wonder how many he has attended.

By the way, I'm inviting class members to stake their claim on who has attended the most reunions. I suspect there are some classmates who have been to all of them and I'd like to get a card from all of you to stake your claim. I'll think up some appropriate prize to present at the reunion. Until next time, keep thinking "REUNION."—**Gilbert D. Gardner**, secretary, 1200 Trinity Dr., Alexandria, VA 22314, (703) 461-0331

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Cathy and **George Schwenk's** cat, Crathern, normally sends out letters at Christmas. In answer to my recent requests, however, Crathern has sent a summer letter informing us that **Stan Kolodkin** and **Marv Caplan**, president and senior-vice president respectively of XENERGY, Inc., shared the award, Entrepreneur of the Year in Environmental Technology for Northern New England, presented last June. A week earlier, the New Hampshire High-Tech Council had given **Dick Morley** its Entrepreneur of the Year Award for lifetime achievement. Dick, of course, was not present for the ceremony—he was traveling on business—so his wife, Shirley, had to accept for him. Finally, Crathern tells us that George and Cathy spent much time last summer at camp: botany, Boy Scout, etc.... **Howard Brody** sends a note describing his latest adventures. He and **Vic Braden** have produced a video, "The Science and Myths of Tennis." Howard has given lectures during the year on the physics of tennis in Israel, Germany, and California. He is working on a high school physics text and has recently published the book, *Tennis Science for Tennis Players*. Officially, Howard is professor of physics at the University of Pennsylvania.

It is with real sadness that I report the death of **Art Haines**. Art and I worked together for four years on *The Tech* during our undergraduate days. I received a wonderful letter from his wife, Beverly, written only two days after he died on August 5. Art developed heart problems last April but appeared to be recovering. However, he passed away quietly while watching the Olympics on television. Over the years, he had worked at Hewlett-

Packard and had managed a Dairy Queen franchise. He and his family lived in Sacramento, Calif. Our sincere sympathy goes to Beverly and their children Kyle, Donel, and Barry.—**Edwin G. Eigel, Jr.**, secretary, 33 Pepperbush Lane, Fairfield, CT 06430

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Joyce Davis reports that she has moved from San Diego to Arlington, Va., and now is working for the federal government in D.C. She is with the senior technical staff of a new agency, the Defense Nuclear Facilities Safety Board, which oversees Department of Energy Facilities.... **Sheldon Busansky** has retired from Honeywell where he was vice-president for business development for the Space Systems Group. He has started a marketing consulting firm and is teaching at the University of South Florida.

There was an East Campus mini-reunion in Chatham over Memorial Day attended by Linda and **Jerry Zindler**, Rita and **Robert Posner**, Mary Glen and **Samuel "Sandy" Goldman**, Ellen, Laura (age 2) and **Marvin Biren**, and Leah, Jenny (age 5), Elise (age 3), and **Ralph Wanger**. Ralph reports that everyone is healthy and employed. Jerry Zindler is a co-founder of Design Continuum, which was featured in *Business Week* this past summer because of the Spalding inflatable baseball mitt the company designed. Ralph has been manager of the Acorn Fund since it was formed by Harris Associated in 1970. Starting with \$7 million, Acorn has grown to \$1.2 billion in assets. Wanger Asset Management is doing a management buy-out and will run the Acorn Fund as an independent partnership. Ralph, his wife, Leah, and four others will be the partners in the new firm. There was an excellent write up on Ralph and the Acorn Fund in *MIT Management*, Spring 1992.

Ralph gives the rest of us two challenges. In October 1991, he was on a panel at MIT (Sloan School convocation on financial technology). Then in April 1992, his son Leonard (BS Iowa, MS Cornell in computer science) gave a paper at the MIT Media Lab conference on visualization, talking about generating shadows. Ralph notes that "most of us generate shadows all the time, some even bigger shadows than we had in 1955, but Len does it on a computer." Have any of the rest of you got similar parent/child success stories for us? Ralph's second challenge deals with progeny. He suggests that Marvin and Ellen Biren's 2-year-old daughter, Laura, may be the last of the '55 kiddies. Any takers?—Co-secretaries: **Roy M. Salzman**, 4715 Franklin St., Bethesda, MD 20814; **James H. Eacker**, 3619 Folly Quarter Rd., Ellicott City, MD 21042

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Our Class President **Lloyd Beckett, Jr.** is pleased to inform the Class that Professor Edmund Bertschinger's three-year term as the Class of 1956 Career Development Professor will end this summer. We are delighted to announce that Professor Bertschinger was granted tenure July 1, 1992. Many classmates had the pleasure of meeting him at our 35th Reunion and we all wish him continued success in his research and teaching.

Professor Mark S. Wrighton, provost, notified Lloyd on June 26 that Professor Deborah K. Fitzgerald has been appointed the new Class of 1956 Career Development Professor for a three-year term commencing September 1, 1992. The following information was furnished by Provost Wrighton's letter to Lloyd. Professor Fitzgerald, a faculty member in the Program in Science, Technology, and Society, earned an undergraduate degree from Iowa State University and an MA and PhD from the University of Pennsylvania. She taught at Harvard University in the Department of History of Science for three years before joining the MIT faculty in 1988. Professor Fitzgerald teaches

courses in the social and political implications of technology, invention in America, and technology in American history. She is the author of *The Business of Breeding: Hybrid Corn in Illinois, 1890-1940* (Cornell University Press, 1990). I am sure I speak for all members of the Class in welcoming Professor Fitzgerald.

Lloyd mentioned that he is moving to the Belmont Day School in the fall, teaching math and science to fifth and sixth graders.

I am sorry to report that Mrs. **Dorothy O. Schlag** of Redlands, Calif., died this spring. Mrs. Schlag was in the field of architecture. Please send news.—**Ralph A. Kohl**, cosecretary, 54 Bound Brook Rd., Newton, MA 02161

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Larry Young has been elected to the Institute of Medicine. He has been particularly interested in the causes and prevention of space motion sickness.... His many friends will be saddened to learn that **Jules Byron** died on April 26 of cancer. He had been president of Byron Realty Group and Williams Realty Group of Long Island, a contract bridge life master, and an active fund raiser for the United Jewish Appeal.

In the last notes I promised to fill the class in on the current holder of the Class of 1957 Career Development Chair. As of July, the holder of the chair has been Assistant Professor Lynn Andrea Stein of the Department of Electrical Engineering and Computer Science. She received an AB from Harvard and Radcliffe and a master's and PhD from Brown. However, her father is an MIT graduate, so coming to MIT was something of a return for her.

Her major interests are in artificial intelligence. She writes, "My dissertation focused on the problem of formalizing commonsense reasoning, establishing a sort of 'competence theory' for the behavior we might expect of our intelligent systems. Since coming to MIT, I have shifted direction somewhat and begun to address the problem of how we might build such intelligent agents. In particular, I'm tremendously excited by recent progress in robotics and the unique opportunity it provides to reshape our understanding of traditional AI issues, such as language and symbolic reasoning. My more recent work takes existing robotic systems and attempts to give them the kind of abstract reasoning ability we share with other humans. The Class of 1957 Chair will allow me invaluable freedom to pursue this research direction."

She has taught both recitation sections and lectures in 6.001. She is concerned that the high level of teaching in the department be maintained and expects that the chair will provide time and energy for her project to improve the teaching skills of current graduate students. She closes her letter: "Finally, the timing of the Class of 1957 Chair was impeccable. I received word of its award less than two weeks after the birth of my younger daughter (Class of 2014?), and the vote of confidence that it represented was a tremendous boost and a wonderful way to return to work. Please extend my sincere thanks and heartfelt appreciation to the members of the Class of 1957."—**John Christian**, secretary, 23 Fredana Rd., Waban, MA 02168

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35th Reunion

Even as the Thanksgiving and Christmas holidays draw near, our 35th Reunion Committee, headed by co-chairman **Cole Bess** and **Stan Klein**, is hard at work. Included among the committee members planning the festivities are **Milt Jones**, **Roy Scarpato**, **Gary Fallick**, **Al Russell**, **Liz Drake**, **Mike Brose**, **Dick Rosenthal**, **Marty O'Donnell**, **Frank Tahmouh**, and **Glenn Strehle**. So plan now for a business trip or vacation around June 3-6, and see old friends and classmates at the reunion.

It's clear that the reunion spirit is in the air.

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Recently, six classmates from Massachusetts, New York, New Jersey, and Connecticut all met in New York City at Tavern-on-the-Green for lunch. On hand were Ginny and Leonard Eng, Ceres and Joel Shulman, Sonja and Terry Sheehan, Beth and Al Russell, Nancy and Mike Brose, and Marilyn and Craig Viale. Classmates in Course II will remember that Craig spent his first two years at MIT but then transferred and received a bachelor's in mechanical engineering from Rensselaer. Currently, he is a vice-president of engineering at Lau Technologies, a military electronics company located in Acton, Mass.

We received the sad news that Edwin Rose had passed away in Houston, Tex., after a short battle with lung cancer. Ed spent most of his career with Shell Oil Co., as a geophysicist. We extend our sympathy to his wife Mary, daughters Deana and Katherine, and son Eric.—Mike Brose, secretary, 75 Swarthmore St., Hamden, CT 06517

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Please send news for this column to: Allan S. Bufferd, secretary, Office of the Treasurer, MIT 238, Main St., Suite 200, Cambridge, MA 02142

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Were it not for the support of the *Technology Review* staff who sent me three items, this would have been a short column. . . . Starting on a personal note (a hint, dear readers, to please send news about you), Marie and I recently visited Egypt for a few weeks, seeing the sights in Cairo, cruising on the Nile, and marveling at the Pharaonic grandeur of Upper Egypt. It was an unforgettable experience—especially mind-boggling to see firsthand the architectural, artistic, and engineering masterpiece of 50 centuries past. Marie and I are splitting weekends between our home in Arlington and a Manhattan apartment across the street from Lincoln Center. While I am still in the Office of the Secretary of Defense, Maris is now in the UK's Oxford University and headquartered in the Big Apple.

In the April 1992 notes, I reported on the architectural achievements of Richard Bertman. I now have in hand an article from the Quincy, Mass., *Patriot Ledger* describing a sculpture exhibit featuring his whimsical and interactive works. According to the *Ledger*, Bertman's work can best be described as "fun." His welded wire pieces—abstract, realistic, and funky—are designed to make one smile. He says he likes to "poke fun at art and loosen people up...so [art] is not so intimidating." One of his most interesting works is "Rain Maker," an interactive bicycle-like piece that when pedaled moves hanging leather raindrops up and down. His self-portrait, in welded wire, sings "It takes a worried man..." when a button is pushed. Keep entertaining us, Dick.

On the political front, I have a report that Tom Heinshimer is seeking re-election to the Rolling Hills, Calif., City Council. Tom has been in the news regarding his long-duration balloon flights, where his companions included—if my memory hasn't failed me—the late Malcolm Forbes. I don't have the outcome of the City Council race, but perhaps Tom will let me know. Hope you're still serving, Tom.

Finally, the *Princeton University Weekly Bulletin* recently reported the appointment of Howard Rosenthal as professor of politics effective July 1993. Howard is currently a professor on the Carnegie-Mellon faculty, having been there since 1966. The article points out that Howard, the author of two books and 70 articles, has also been a visiting professor at numerous prestigious institutions, including MIT, CalTech, and Stanford. He currently is also a fellow of the International Center for Economic Research in Turin, Italy. Best wishes, Howard, in your new appointment.—Frank A. Tapparo, secretary and class agent, 15 S. Montague St., Arlington, VA 22204

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In September Max Keck moved to Cincinnati to work at Xavier University. He writes that he is dean of the College of Arts and Sciences after a two-year stint as academic vice-president at Rockhurst College in Kansas City. Congratulations, Max!

The Woburn (Mass.) *Times Chronicle* had an impressive picture of Bill Hecht "entertaining" the third grade at the Barrows School. They were studying electricity, and he showed them a variety of devices during his talk. The picture shows that the pretty teacher was very attentive but the students were more interested in the photographer. A terrific picture.

How is the recession affecting you people? Let us know by writing to: Andrew Braun, secretary, 464 Heath St., Chestnut Hill, MA 02167

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Irv Thome and his family really enjoyed the 30th Reunion in June. Irv's son, Randy, is a senior at RPI, majoring in mechanical engineering and was a big asset for the MIT '62 reunion games team. Irv's daughter, Cherry, is a sophomore at Barnard, and spent the summer at Tanglewood studying flute with Doriot Anthony-Dwyer. Irv and his wife, Hetty, live in Norwich, Vt. They consolidated families in May 1988. He started an interface consulting practice, Succinct Systems, in 1984, after 10 years at Dartmouth's Thayer School of Engineering, and launched his first software product, Sizelt, this past spring. Sizelt is designed to fully utilize the scalable fonts available in Canon printers used with IBM PC's and PC compatibles.

Bill Levine and his wife, Shirley, made it to the 30th, and had so much fun they promised to try to make the 35th. Mary and I enjoyed the opportunity to visit with Bill and Shirley and catch up on their activities since I introduced them to each other in the summer of 1962. Bill is professor of electrical engineering at the University of Maryland and Shirley keeps active in the suburban Washington, D.C., cultural circles with puppet theater activities and other artistic endeavors.

Follow Course XII (geology and geophysics) classmate, Phil Nelson, dropped us a nice note after the reunion. He and his wife, Joyce, are living in Denver, and were in New England to attend son Erik's graduation from Brown University. Phil didn't make the reunion due to crew races at Syracuse that same weekend. His son Alex, rowing with Brown's Varsity "Four" set a course record as well as winning the meet final. Brown's varsity eight, with son Erik on board, came in second in their heats, but came back to win the petite final. During their New England swing, Phil and Joyce visited with classmate Ken Koerber and his wife, Sue, near Concord, N.H. They then attended Joyce's reunion at Mt. Holyoke College. Phil has been with the U.S. Geological Survey for five years, working on a variety of resource and scientific projects in his specialty: the acquisition and analysis of geophysical data from boreholes.

A note from R. B. Halaby at AgriCapital Corp. in New York, put us back in touch with Peter Sadow, who is now living at 5175 Reymosa Road, St. Louis, MO 63128, but also brought the news that Dirk Berghager had passed away in Portugal in 1984. Dirk's wife, Jenny Aagaard Berghager, is still living at Rua Afonso Lopes Vieira #507, Cascais 2750, Portugal.

Hans C. Andersen, professor of chemistry and director of the Stanford University Center for Materials Research, has been elected as a Fellow of the American Academy of Arts and Sciences and also a member of the National Academy of Sciences. Hans was recognized for his distinguished and continuing achievements in original research in physical chemistry, applied statistical mechanics, development and use of molecular dynamics computer simulation methods, theory of liquids, and theory of glass transition and relaxation processes.

Harry Haige writes that he has spent most of the last year sailing around the world on a series of Italian cargo vessels, some of which use the navigational equipment he helped design in the 1960s. Harry has had long visits in Australia and Africa during his various trips. . . . **Peter R. Shrier, M.D.**, has joined the obstetrics and gynecology department of General Medical Associates in Wayland, Mass. After graduation from MIT and the University of Vermont College of Medicine, and a residency at Thomas Jefferson University Hospital in Philadelphia, Peter practiced OB/GYN in Maine for 20 years before moving back to Massachusetts. He is a Fellow of the American College of OB/GYN and the American College of Surgeons.

If you have an e-mail capability and haven't subscribed to MIT1962 (now operating through the MIT Computer Systems), please do so. You may join the network by sending the message text: SUB MIT1962 to LISTSERV@MITVMA.MIT.EDU on the Internet system. If you can't figure that out, just send a message to MIT1962@MITVMA.MIT.EDU or to HMCARL@ENGYSYS.ENG.UAB.EDU and we'll put you on the e-mail network. We would like all classmates with e-mail connections and the ability to communicate with Internet/Bitnet/Telnet, to sign up on the network. The Alumni/ae Association will be requesting your e-mail addresses and setting up a master system for all classes, but we are pioneering the effort with our own network as a trial run for the rest of the Association.

As always, even if you don't use high-tech communications, just send a note or card via the U.S. Postal Service to: **Hank McCarl**, secretary, P.O. Box 352, Birmingham, AL 35201-0352

63 30th Reunion

It's time-warp time. As I write, in early August, the presidential campaign is heating up. And yet...when you read this it will all be over. Who will win? What unexpected events will change the course of the election? I suppose I will just have to wait and watch.

I got a short note from **Jonathan Gross**. He was honored by the Columbia University School of Engineering and Applied Science, as its outstanding teacher of 1991/92 for his teaching of combinatorial analysis. It's good to know universities still respect pedagogy enough to take that step, and that Jonathan cared enough about his students to teach them. . . . **John Wawrzonek's** gallery, in Worcester, Mass., is making a mark in the display and reproduction of fine photographs. You may recall that he is a leader in the dye-transfer technique. He's been working with the oeuvre of Ernst Haas, Ansel Adams, and Eliot Porter, and his own photographs. If you're in the area, call the gallery at (508) 798-6612 for driving instructions and to find out what they are showing.

As usual, I must remind you to send some news. Several of you have been taking advantage of electronic mail—e-mail. (Actually, this column is going to MIT by e-mail.) If you have access to CompuServe or Internet, try it. It works, it's inexpensive, and it's quicker than the Postal Service (aka snail mail). Tell us all about kids, grandkids, your career, etc.—**Phil Marcus**, secretary, 3410 Orange Grove Ct., Ellicott City, MD 21043, (410)-750-0184, CompuServe: 72047.333; Internet: 72047.333@compuserve.com.

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As you read this column, we won't be eating the tomatoes that Louise wanted to can over the summer because they never ripened. It was a rather cool and wet summer in Vermont, due to El Niño and the Mount Pinatubo eruption, so they say. I guess it's time to conjure up two or three empirically based papers on "global cooling" to present to the prognostication crowd.

Our Reunion Gift generosity has begun to show

tangible results. The Institute's Financial Aid Office sent along a report on the first recipient of the Class of 1964 Scholarship: **Alfredo Armendariz**, a junior Course X major from Tucson, Ariz. He is concentrating his studies in environmental organizations. His main extracurricular interest is music, including playing guitar in a campus-based rock/blues band: **Alfredo** has maintained a paying job each semester on campus. Bravo to him for his hard work and to us for our generosity! When it's time to think about your next fund gift, please keep in mind the very good uses to which it will be put.

In a note in which he sent along a copy of **George Piotrowski's** obituary, **El Wolcott** also provided some news of his family. Daughter Charnley graduated from Furman in June with an AB in elementary education and plans to teach in the Greenville, S.C. area. A July 11 wedding was also on her calendar. Son Kedron, '90, received a master's in aero/astro from Stanford in June as well. Congratulations to all the Wolcotts.

Douglas McCallum writes that he is still living the Hague, working for the Institute for Housing and Urban Development Studies in Rotterdam, where he deals with economic and planning issues in Third World urban development. Aside from three months or so overseas (China, India, and Indonesia mostly), he is in Holland most of the year and happy to see any classmates passing through.

Chris Ritz has been appointed director of the Executive MBA Program and professor of management at Queens College in Charlotte, N.C. He looks forward "to the challenge of continuing the growth of a quality program in the New South." Chris and wife Suzanne are relocating to Charlotte from Philadelphia, where he was a member of the visiting faculty at the Wharton School.

A clipping from the *Vineland (N.J.) Daily Journal* provided news that **Ralph Zimmerman** had been selected to serve as an International President of Jury in the fencing competitions at the 1992 Olympic Summer Games in Barcelona. He is a top-ranked official, having worked the 1984 Olympics, the 1990 World Championships in Lyon, and the 1991 Junior World Championships in Istanbul. Personal data in the article include the names of his wife, Nancy, and daughter, Mary. We are hoping for a note from Ralph describing his experiences in Barcelona.

Jeff Michel continues to be based in Europe, where he is active in various environmental programs. In late 1991, he was employed as a consultant by the Czech Environmental Ministry, working on that republic's "very progressive" environmental impact legislation. He served as coordinator of the German-American Environmental Days in Freiburg, Germany, in May 1992 and chaired the symposium, "Toward Healthy Cities," in Brno, Czechoslovakia, in June. Jeff was a contributor to the World Resource Institute's *Guide to the Global Environment* and has worked since 1990 supporting youth environmental projects in the eastern part of Germany. Busy times, important efforts!

Our final item is an announcement from MIT that **Gerald Burnett** was elected a term member of the MIT Corporation, the body that considers broad policy issues for the Institute and oversees the 25 Visiting Committees that provide critical counsel to each academic department. Gerald earned an SB and an SB in Course VI and a PhD in computer science from Princeton. He was employed by Rockwell International and Index Systems before becoming a founder president of one of the Teknekron, Inc., companies, a systems engineering and development firm specializing in advanced technology. Over the years, he and associates built a number of successful technology-related businesses. Gerald has been president of Visionary Corporate Technologies, Inc., of Palo Alto, Calif., since 1989.

Personal notes. . . . The interactive video programs developed by the medical research foundation that I'm running have recently received positive publicity in diverse media including *Newsday*, *Glamour*, and *Family Circle*. We keep hoping that Katie Couric and the *Today* show will be next. In other aspects as well, all is right with the world. Daughter Jennifer, our recent Vanderbilt graduate,

has decided to take up golf, her boyfriend is a nice fellow and golfs, and she has a job!

Send news of your accomplishments, both major and minor.—**Joe Kasper**, secretary, RR 2, Box 4, Norwich, VT 05055

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A long column this month. With any luck this will be timed right to remind you to watch for a special program on *Beyond 2000* (usually carried on the Disney Channel) featuring work in the psychology of queuing by **Dick Larsen**. Dick is co-director of the MIT Operations Research Center, "the oldest continuously running interdepartmental program at MIT," with over 50 graduate students. He is also president of the Operations Research Society of America.

Dick reports supervising sons Eric (12) and Evan (9) not only in baseball and soccer, but also in rock-ets. Daughter Ingrid (6) is only old enough to watch (so far). Dick spends much of his summers at a farmhouse in Maine. He keeps in touch with **Al Pogeler**, **Charlie Anderson**, and **Charlie McBride**. His work on the psychology of queuing theory appeared on 20/20 this year and focuses on what happens while we are waiting.

Herb Mower has moved back into the Boston area, accepting a position at the Lahey Clinic. Lahey is a leader in high dose rate radio-surgery. He has two daughters—one a junior at the College of Wooster in Ohio, the other a junior at the Westford Academy.

I had another of my coincidental alumni interviews recently when I had a business meeting with Chemfab and found **Neil Lupton**. Neil is VP for Technology Development at Chemfab. He reports having achieved his 25th wedding anniversary recently and that his daughter, Kate, is now at Stanford. His wife, Clair, runs a one-person advertising agency in Boston and counts the *New England Journal of Medicine* among her clients. Neil went to Yale after MIT, then into the military, and then through a series of companies in polymer-related areas before joining Chemfab. He continues to be active in Boy Scouts and he and his wife help in the "Boston Urban Gardener" area (greening Boston).

Steve Lipner reports that he is now director of Information Systems for MITRE in McLean, Va. Steve had been with Digital Equipment, most recently as manager of Digital's Secure Systems Group. . . . **George Berry** continues to teach computer science at Wentworth, where he is working on software to help in writing (grammar, spelling, etc.). Daughter Alison recently started an internship with a publisher after graduating from Sarah Lawrence. Daughter Amy is a freshman at Berkeley.

By coincidence, I also talked with **John Berry** this month. John and I had experienced Jay Forrester together. John moved back to Maine 16 years ago and joined Oakhurst Dairy as treasurer. Oakhurst is the largest independent dairy in Maine (about the same size as Hood). One son is at MIT, another at Dartmouth ("only three more tuition years"). John coordinates the MIT Educational Council locally and is involved with youth soccer. He says the final decision to go back to Maine was driven in part by the ability to cross-country ski from their back-door step.

Bill Collins reports an exciting and varied life from the Mexican border. Bill operates a number of companies from McAllen, Tex. He consults on building maquiladoras and has the local franchise for Mailboxes, etc. (both southern Texas and northern Mexico). Bill continues to be a private pilot ("of course you can fly back and forth across the border"). He talks about the area as more like an oasis than a border. Wishes MIT had taught him more about "retailing."

Bob Silverstein wrote that he became general manager of Northrop's Electronic Systems Division in 1990. Bob's wife, Ellen, is in graduate school at UCLA getting a master's in social work. Son Seth graduated from MIT in 1990 and works for Liquid Aire, daughter Rachel graduated from UCLA this

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year, and daughter Alison just started college. Bob reports regularly seeing **Mike Oppenheimer**, "who still dives in Florida."

Finally, I received a very formal letter from a prestigious Washington law firm and enjoyed the letter from **Chico Gholz** proudly reporting his son Eugene's recent graduation from MIT with a 4.9 cum.—**George McKinney**, secretary, 33 Old Orchard Rd., Chestnut Hill, MA 02167, (617) 890-5771

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Only two notes this month, but both from alumni who sent their sons to MIT. **Mark Yogman** writes that his son, Larry, began his freshman year at MIT in September. **Wayne Stevens'** son, Russell, '91, has defected to Stanford for graduate school while working for Hughes Aircraft. Wayne has just transferred with IBM to the Southbury, Conn., corporate campus as a consulting systems designer. After 25 years with the company, he is a select member of IBM's Quarter Century Club. He has written another book, *Software Design*, one of five in a series on the application development process. His daughter Wendy is at UMich, Ann Arbor, and wife Penny is graphics coordinator at James River Corp. . . . By the time you read this Cheryl, '91, and I will have hopefully enjoyed and/or survived a back-packing trip on the Appalachian Trail in Virginia. . . your assignment: "What I Did on My Summer Vacation." Send your essays to . . . **Eleanore Klepser**, 84 Northledge Dr., Snyder, NY 14226-4056

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Our 25th reunion was simply outstanding, and everyone was happy to be part of it. We received numerous glowing comments. Here is **Jeff Schoenwald's** tribute: "The reunion was great! My warmest thanks to **John Rudy**, **Lutz Hernckels**, and everyone else who worked so hard to make it a success. My family—especially the kids—were treated royally. Looking forward to '97!" . . . **John Fittz** writes that both he and Joan enjoyed our 25th immensely. John has been serving as a church organist for the past year. He also reports that ABB is aggressively pursuing total quality- and time-based management and supply management initiatives to become "world class" in all of its markets. John and Joan's 18-year-old son will graduate in January from Grenville Christian College, a prep school in Canada. Their daughter Kristie is 15 and a junior at The Master's School in Simsbury.—**Sharlotte and Jim Swanson**, co-secretaries, 878 Hoffman Terr., Los Altos, CA 94024

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25th Reunion

Please send news for this column to: **Gail and Mike Marcus**, secretaries, 8026 Cypress Grove Ln., Cabin John, MD 20818

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Michael J. Ginzberg "continues to keep busy chairing the IS department in Case Western Reserve University's Weatherhead School of Management and developing relationships with universities around the world." . . . We hear that **Randall J. Heckman** has resigned his post as a probate judge (which he held for 15 years) to begin the Michigan Family Forum in Lansing, Mich., to advocate for traditional values with government, churches, and individual families. He and wife Marcia have 11 children aged 1 through 20!

The Nashua, N.H., *Sunday Telegraph* profiled **Larry Hill** who is now president of Cyplex Corp. of Hollis, N.H. Founded in 1983, the company specializes in

communication over power lines. Hill was responsible for the design of the company's initial product.

I am getting deeper into hands-on engineering, but I have not given up my writing career. There will be lots more to write about! In August, I became VP for research at Clustron Sciences Corp. in Vienna, Va. The company was founded to commercialize cold fusion power systems and other technology based on new nuclear science. We are moving rapidly ahead using new insights about nuclear behavior from the nucleon cluster model, which was developed by nuclear chemist Ronald A. Brightsen, SM '50. I'm still living in an idyllic setting in Bow, N.H., to which I return on weekends.—**Eugene F. Mallove**, secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03304

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Joe Diliberto tells us that he is presently a group leader at the MITRE Corp. in Fort Monmouth, N.J. . . . **Wesley Moore** writes that he is still in aircraft design at the Boeing Military Aircraft Division, "learning that it's hard to make airplanes that land on carriers and do anything else very well." . . . **Greg Palm** has resigned his partnership at the law firm of Sullivan & Cromwell to become co-general counsel of The Goldman Sachs Group, L.P. in London.

Keep sending us notes and messages.—**Greg and Karen Arenson**, secretaries, 125 W. 76th St., Apt. 2A, New York, NY 10023

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John L. Kulp, Jr. is VP for research and development and founder of Symbolics, Inc. (spinoff of the MIT AI lab) and the president and founder of SuperScript, Inc., a pen-based computer company.—**R. Hal Moorman**, secretary, Box 1808, Brenham, TX 77834

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Please send news for this column to: **Dick Fletcher**, co-secretary, 135 West St., Braintree, MA 02184

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20th Reunion

Please send news for this column to: **Robert M.O. Sutton Sr.**, secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA 22115

74

A pleasant early winter to you all! Did anyone get to the beach this past summer? Your faithful scribe got in his one round of golf this summer, shot a 108, and put the clubs away for next year. Everything in moderation, I always say.

Dave Withee fired off an epistle in late July telling of his adventures in the past year. The company he had been working for was sold out from under him to a competitor, a "devastating personal experience" he says, due to short-sightedness on the part of top management. "From a purely analytical viewpoint," however, "it was a classic example of a move by one company [the competitors] to keep the middle managers they knew and valued by purchasing another company to provide promotion opportunities." The new job is fortunately still in Iowa as the gas fireplace product manager for Heatilator. The product is new and Dave's opportunities for advancement are bright. "One way or another, I will be the president of a manufacturing firm someday."

While we're on the topic of major life changes, **John Sitarski** done got hisself hitched. John met his

wife, Karoline, while playing golf in Las Vegas, and the two are just back from their honeymoon in the Canadian Rockies. . . . Which brings up the topic of families. **Mary McCarthy** writes that Betsy (11), Mary (9), Susan (7), Tom (5), and Margaret Rose (3) are enjoying the outdoor California life while Mike is stationed at Rocketdyne. Their stay has another year to go. Mary is busy being PTA president and of course a mother, but she will be "back at work in a few years." . . . Class Agent **David Shiang** is now working for Global Partners, Inc., in Boston, helping client businesses branch out into international markets. His wife, Helen, is working in the third-party marketing division of Banyan Systems, the makers of computer networking systems.

Johan Norvik is "just starting the third and last year of my assignment to Unisys' Europe-Africa Division in Uxbridge, England. We have enjoyed the first two years and hope to make the best of the third. Our home is in Gerrards Cross, a village 20 miles west of London and six miles from work." . . . **Frank Morgan** has completed a new book, *Riemannian Geometry: a Beginners Guide*, published by Jones & Bartlett.

And finally, I'll leave you with this thought from Dorothy Canfield Fisher: "One of the many things nobody ever tells you about middle age is that it's such a nice change from being young."—**Lionel Goulet**, secretary, 115 Albemarle Rd., Waltham, MA 02154-8133

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Only one item this time: **Michael M. Bissel** is a control systems/electrical discipline supervisor for Bechtel's Kingsport, Tenn., office. He was recently married (for the first time!) to Hilda McGlew, a physician. They are living happily in the Appalachian foothills with two cats. So who else out there lives with cats? Why don't you write and let me know?—**Jennifer Gordon**, secretary, 18 Montgomery Pl., Brooklyn, NY 11215

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Finally, after 16 years, we have word from **Mike Rabkin**: "After graduating from MIT, I went to Duke University Medical School, where I received both an MD and a PhD in physiology in 1984. I then did a residency in anatomic and clinical pathology at the University of Utah in Salt Lake City, followed by a fellowship in dermatopathology (skin pathology) at the University of Alabama at Birmingham. After finishing my training, I became an assistant professor of dermatology and pathology at the University of Pittsburgh Medical School. However, I eventually decided to start my own laboratory, and did so in March 1991. It is located in downtown Pittsburgh and is immodestly named Rabkin Dermatopathology Laboratory. I specialize in the diagnosis of rashes, skin cancer, etc. on specimens sent to my lab by dermatologists and other physicians. I enjoy diagnostic pathology and running my own business and I am glad that I decided to leave academic medicine. Since 1982, I have been married to Beth Victor Rabkin, Mount Holyoke College, '80, Duke Law School, '83. Beth recently left law and is now a secondary school social studies teacher. We have one child, Barry, who is 8 years old. I can be reached at: Rabkin Dermatopathology Laboratory, 411 Seventh Ave., S. 1011, Pittsburgh, PA 15219, (412) 471-9460."

Jonathan Maybaum writes that he has been associate professor of pharmacology, University of Michigan Medical School since 1989. "Wendy and I have two children, Alex (10) and Rebecca (8). I do a bit of computer networking in my spare time. Send e-mail to JONATHAN.MAYBAUM@MED.UMICH.EDU. 'Hi' to Craig, Harry, Jeff, Rick G., Jon V., and Chip." . . . **Carl Shapiro** is "now a professor of business and economics at UC Berkeley, after 10 years teaching at Princeton. The Bay Area was just too tempting. Eva (5) and Ben (3) are thriving, along with Dawn." . . .

Evelyn Brody writes: "After nearly four years in the Office of Tax Policy at the U.S. Treasury Department, I'm moving to Chicago to teach tax at the Chicago-Kent College of Law (affiliated with the Illinois Institute of Technology)."

As you can see, we are woefully short on news. Your secretary prefers being short other things, such as selected stocks, rather than news. So communicate!

Insofar as your secretary is concerned, he has parted from Wall Street again, and continues to bang away in the world of high tech. It is to be hoped that by the time these Notes are printed, he will have concluded a contract to develop, for a Japanese firm, a radical combination of advances in image analysis for laparoscopy. (The Japanese were the only ones interested; my ongoing experiences with American companies leaves me convinced that this nation is indeed, in many areas, in a decline.) This is just one pending project—I have many others. As an entrepreneur, one can never depend on any one project; the only dependable factors are death, taxes, and competition. However, trading futures all these years has turned me into, I have been told, a formidable competitor.

Please write, fax or call. We need your news.—**Arthur J. Carp**, secretary, Quantalytics, Inc. 220 Henley Rd., Woodmere, NY 11598-2523, (516) 295-3632, Fax: (516) 295-3230

77

First, some non-reunion news. **Victor O. Li** was elected an IEEE fellow in January for contributions in the design and analysis of communication networks. He is one of the co-directors of the Communication Sciences Institute at USC, a position he has held since July 1991. . . . "Still happily unmarried" in Palo Alto, Calif., is **Brad Basler**. He is a mechanical engineering manager at Acuson Corp., one of the premier manufacturers of diagnostic ultrasound equipment. He had a scuba diving junket to the Bahamas planned for this June. So, he and 850 of his classmates missed a wonderful time at our 15th Reunion. Details elsewhere in this column.

I received a nice note from **Jim Pollock** who is now living in Texas, having recently moved from Columbus, Ohio. He has taken the plunge and started his own company, BusinessWorks, a venture that will be helping corporations meet their training and information distribution needs by bringing interactive multimedia down to earth. "I'm finally going to get to play when I work," he writes. He also had news of many other classmates/fraternity brothers whom he saw at a summer wedding here in DC. In his words, "**Jeff Singer** finally married Dado Petrus on June 13, 1992. Jeff works for Hughes, sending 1s and 0s into space as fast as possible! Jeff called me in December 1990 to let me know he was engaged and would be having a traditional June wedding. Knowing how careful Jeff is, I joked, 'June when? '92?' I was right—one and-a-half-year engagement after dating since before my birth. **Dave Welland** came up to DC from his new job in Austin, Tex., with Crystal Technologies. **Ken Stecklein** and wife Hilary Stecklein (Wellesley '77), brought their two adorable kids. **Kenny** is doing a bit of architecture via the free-lance method. **Ed Cluss** flew coast to coast from the San Francisco area to be with his Delt classmates. **Ed** is a big VP muckety muck with Aspect Telecommunications in the Bay area. Other generations of MITers in attendance included **Mike Raphael**, '79, **Ken Kevarian**, '79, and old timer, **Paul Pilorz**, '75." Jim welcomes anyone who wants to have a friendly place to visit in the Dallas area to give him a call at (214) 669-8839. He also pointed out that BusinessWorks is viewed as a virtual company with resources scattered around working together, so he would be happy to hear from anyone interested in Multimedia.

Still waiting for a tidbit from the reunion? Class elections were ably run by **Eric Black** on Friday evening. The class elected **Carol Catalano Martin** president; **Glenn Brownstein**, VP; yours truly, sec-

retary/treasurer; and **Leonard Evenchik**, **Kevin Miller**, **Russell Nevins**, **Fred Rust**, executive committee.

Now back to the regular news. . . . I finally found that letter from **Carlos Acevedo** that I misplaced back in September 1991. At that time Carlos wanted us to know that he had just left Digital Equipment after a successful 14-year career doing design project management and finally quality management. He moved to a small company, Signal Transformer, as the corporate quality assurance director. That was quite a change after DEC, and he was liking it quite a bit! He was also enjoying being a father to his then 16-month-old son. I promise not to misplace for 11 months any subsequent letters you write, Carlos. Thanks for your patience!

From the AMITA newsletter, we learn that **Diane Zingale** has been in Tokyo for the last seven years. Originally a principal engineer with DEC and Northern Telecom, she is now assistant VP at Citibank and is data center manager for global finance. She received her third black belt in aikido last year and is also studying sword. . . . **Dana Backman** is professor of physics and astronomy at Franklin and Marshall College in Lancaster, Pa. He was planning to spend the summer of '92 back with the Kuiper Airborne Observatory group at NASA, Ames in Mountain View, Calif., on a visiting fellowship from Stanford and NASA. . . . A brief notation from **Arthur Perez** informs us that he and his wife, Jeanne, are being kept busy by their 20-month-old son, Tommy. He recently ran into classmates **Barbara Thornton** and **Richard Smiley** who were expecting their first child this past summer. . . . An equally brief blurb from **Stanley Pomerantz** tells us that he was recognized by *Communications Week* as one of the top 25 visionaries in the networking industries in 1991. . . . **Cliff Edson** and wife, Lynn, announce the birth of their son, Maxwell Lewis Edson. Cliff has been in southern California for the past 10 years as VP for marketing/planning at Princess Cruises, *The Love Boat*.

Sergio Cabrera sent me a letter from San Diego (where he was spending the summer) letting us know that he recently moved to El Paso where he is an assistant professor in the Electrical Engineering Department at the University of Texas. . . . Four of our classmates along with the other MIT alumni/ae who died between April 1991 and March 1992 were remembered in a memorial service at the chapel during reunion weekend. We paid tribute to **Robert Bon Foster**, **Richard E. Maebius**, **Roger L. Renshaw**, and **Ian C. Smith**. . . . The reunion activities for our class included the First Annual Reunion Challenge Games on Saturday afternoon. This was a kind of college bowl-sports festival-kindergarten picnic all rolled into one, pitting the Classes of '62, '67, '72, '77, '82, and '87 against each other in an all out battle for blood and glory.

The events included an untimed MIT trivia quiz, a volley ball tournament, an obstacle course race, a water balloon toss, a sack relay race, a 2.70 design contest, a calculus derby, and a tug of war. Our class was admirably represented and lost only due to the shenanigans of the 25th Reunion class, which deservedly cheated its way to victory. This event was truly the high point of the weekend for pure fun and laughter and must not be missed! Since it promises to be repeated on a yearly basis, I want to call your attention to it as a special drawing card for our (gulp!) 20th Reunion. We also had a great party at the Pierce Boathouse, a Techas Barbecue before the Challenge Games, an evening event with the classes of '82 and '87, and a Sunday brunch. I hope that you can wait until next issue to hear all the news and tidbits from the reun-ees, because I am already into my second ounce of postage!

I do want to mention that Paul and I spent an evening with **Peter Moss** in Harvard Square, which, just like all of us, looks better with age. Peter is living in Bedford and is back working at BB&N doing acoustical engineering stuff. He is still (eternally?) single, but nevertheless entralled to dine at a fine restaurant with us and our three delightful offspring. I will close for now with the assurance that next issue will bring many more reunion details. I am pleased to be returning as your class

78 15th Reunion

Your class secretary and wife, **Diana Curtis**, and kids were accompanied by Jay Gurley, '76, and wife Carolyn (who happened to be visiting at the time) to see presidential and vice-presidential hopefuls Clinton and Gore when they stopped on their *First 1000 Miles* bus tour in Utica, Ohio, about five miles from our farm. It was thrilling to be at our first political rally, and it was equally thrilling to hear these men speak of their vision for this country and for our future.

We hear from **Jack Lissauer**: "I will be at the Institute for Theoretical Physics in Santa Barbara, Calif., from August until December of this year, coordinating an international research workshop on the subject of planet formation." ... **Mark Camenzind** writes, "I got a PhD in chemistry at UC/Berkeley in 1983 and then headed to Canada for a three-year postdoc at the University of British Columbia. I did inorganic chemistry research during the week and was a raft guide and the touring director for the Vancouver Whitewater Kayaking Club on weekends. I returned to California and have been working the last five years for Balazs Analytical Laboratory in Sunnyvale doing chemical R&D for the semiconductor, instrumentation, and nuclear power industries. I recently married Dorothy Hassler, a pediatrician at Kaiser Hospital in Walnut Creek. We enjoy hiking the drought-stricken hills of California. We will be living in our house in San Ramon, Calif."

Dan Zwilling (zwilling@world.std.com for you net-people) has written a second edition of his bestselling reference work, *Handbook of Differential Equations*, and has also written *Handbook of Integration*. "Both books were selected as 'Book of the Month' by the Library of Science book club. I am now directing a consulting group in applied mathematics and am an adjunct professor at Rensselaer Polytechnic Institute. I am also managing editor for a series of books for the Chemical Rubber Co. Finally, I spent a month in the Middle East on vacation (Petra was amazing), and am now engaged to be married."—**Jim Bidigare**, secretary, 9095 N. St. Rd. NW, Newark, OH 43055-9538, (614) 345-8582

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Jordan Kreidberg is working at the Whitehead Institute in good old Cambridge, Mass. Jordan was married on July 5 to Debbie Clain with quite a few alumni in attendance: **Brian Binder**, **Craig Albert**, **Ed Tarney**, '80, **Paul Lones**, and **Audrey (Greenhill) Lones**, **Doug Grearson**, **Scott Kukshel**, **Paul Malchodi**, **Tom Potter**, **Jim Moody**, '75, **Yvonne Tsai**, '78, **Sandy McCarley**, '80, **John Corea**, '82, **Howard Marson**, '82, and **Jerri Schofield**, '83.

Jeanne Brady, as quotable as ever, writes, "Hey NRSA Buckaroos! Whatever happened to the reunion? I was really looking forward to the lobster (loose, of course!)" ... **Jeffrey deRoulet** lives in Seattle and reports that 1992 has shown strong growth for his three-year-old firm, Architects Northwest, now up to seven employees. He writes, "The economy here is steady but wary. Strong anti-growth sentiments in the Puget Sound area. Architecture interns are encouraged to contact me for summer '93 positions."

I received a letter from the Student Financial Aid Office. No, my loan payments are not overdue—it was in reference to the Class of 1979 Student Aid Fund. We have apparently provided aid to two undergraduates who received their degrees this year (one is continuing at MIT on a research fellowship to get a master's). We are now sponsoring a new crop—two in the Class of '93 and one in the Class of '94. Thanks go out to all class members whose contributions made this possible.—**Sharon Lowenheim**, secretary, 98-30 67 Ave., Apt. 6E, Forest Hills, NY 11374

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Wesley Asbury, Jr. received an MD degree during spring graduation exercises at East Tennessee State University. He also received the obstetrics/gynecology award presented for academic excellence. Wesley specialized in diagnostic radiology and was a member of Alpha Omega Alpha honor society in medicine. He will complete his residency at the University of Tennessee-Knoxville Graduate School of Medicine. Congratulations, Wesley!



Wesley Asbury, Jr. Received two "letters" by way of e-mail. **Michael Monaco** submitted his first bit of news since graduation, so there's a lot of catching up to do: Michael spent four years after graduation in the Navy's nuclear power program, highlighted by a tour on the San Diego-based USS *Haddock* in the western Pacific. During his Navy tour he married his Simmons sweetheart, Nadine, and they have shared a wonderful life since then. For the last eight years he has been at MITRE Corp. in the D.C. area. Michael completed an MSEE at George Washington University in 1991 and is taking more courses this year. He is still in the Naval reserves, has traveled some and has a passion for gardening (a bit hard on those ships!). "All in all...a satisfying existence." Michael also sends news of other classmates: **Phil Beierl** is still active in the Navy and **Dottie Russell Beierl** is in the reserves. Phil is heading back to Sasebo, Japan, to command one of the Navy's salvage ships. Phil and Dottie have four active children and are doing well. (Dottie, Michael says to ask you for one of your great "update notes" for more details! Please write!) Michael has also spoken to **Granta Nakayama** who was at NAVSEA 08 and quite a while ago saw **Tim Winsky** who he believes is still in the reserves and living in the midwest. (According to my records, Tim is in Michigan.) Michael has stayed in close contact with **Jim Scutti**, **Chris Hill**, **Joe Bernier**, and **Debbie Goldberg Bernier**. Jim and his wife, Bernadette, have a son and live in the Boston area. Chris and his wife, Joyce, have two sons and live near Philadelphia. Joe and Debbie have two boys and live in Florida. With all the news Michael Monaco sent I just might make him my assistant! Thanks for all the news.

My other e-mail note comes from **Arthur Hu**, updating the news in the April column. Arthur now works for RAD Technology and is living in San Jose where instead of being the only Asian, he is now one of the few native-born Americans on the block in what people used to call "the suburbs." Arthur and Jenny's son, Eric, who will turn one on Labor Day (1992), is already banging away at his dad's PC. Arthur writes, "If you saw the *New Republic* June 1 piece on the L.A. riots, or heard about some guy who filed a complaint against Berkeley, Harvard, and UCLA about admissions quotas, that was me." I hope this inspires some of you to write. If you enjoy reading about your classmates in this column remember they would like to know what you've been up to since graduation. Send your news to: **Kim Zaugg**, secretary, 2384 Leslie Circle, Ann Arbor, MI 48105, (313) 665-2365, vayda@erim.org

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Some summer highlights: *Baby makes four*. ... **Janice Cohen Chartoff** and husband Marvin, '79, are the proud parents of their second daughter, Sonya Lynn, born June 12. Janice reports that she also graduated this past May from George Mason University School of Law and is now a registered

patent agent with the firm of Birch, Stewart, Kolasch & Birch in Falls Church, Va. (Welcome to the business, Janice.) ... Congratulations to **Jeffrey Watiker** and his wife, Carla, who have had their second child, Sarah Michelle, born last May (1991). **Computer connection**. ... **Rev. Jeffery Solof** informs us that he's been managing MIT's campus computer store since June 1990. Jeff has also had an article published in the May/June 1992 issue of *Educom Review* and chaired the 1992 Campus Computer Resellers Conference this past July in San Diego. Jeff's daughter Elizabeth just turned 6, and son Joe turned 4 in August.—**Mike Gerardi**, secretary, 1515 S. Flagler Dr., #1204, West Palm Beach, FL 33401, (407) 655-5050 (w), (407) 835-9013 (h)

82

Aaron Rapoport writes that he is going to be starting his fourth year of a hematology fellowship in July and his wife, Deborah Lourie (Wellesley '84), is expecting their third child in August. ... **Subir Sachdev** and his wife, Usha Pasi, are proud parents of 2-year-old Monisha. He has been on the Yale physics faculty for five years now, conducting theoretical research on superconductors and antiferromagnets. ... **John Canning** finished a PhD at the University of Maryland in August 1991. He and his wife, June Fox, are living in Tokyo, Japan, while he is working as a post-doctoral researcher at NTT's Basic Research Labs. ... **Samuel Conner** was awarded the first Alan H. Barrett prize for excellence in astrophysics.

Michelle Hunt recently earned a Commonwealth Fellowship, which is awarded to outstanding minority doctoral students by the Virginia Council of Higher Education. She is working on a doctorate in marketing at Virginia Tech. She plans to marry **Andrick Spicer** this October. ... I am sad to report that **Albert Lester** passed away in June when he was struck by a car while participating in a 24-hour endurance bicycle race. He had been working as a software engineer with WSI Inc. of Bedford and Billerica.—**Helen Fanucci**, secretary, 502 Valley Forge Way, Campbell, CA 95008, 74005.744@compuserve.com



Michelle Hunt

83

10th Reunion

The one letter we received this month was from **Michael Wellman**, Ann Arbor, Mich. Michael writes that he's finally paid off his ROTC debt (delayed by graduate school) and is leaving the Air Force to join the EECS faculty at the University of Michigan.

Since we don't have a lot of new news this month, I thought we would take a moment to elaborate on **Cady Coleman**'s selection as an astronaut candidate for NASA. As reported last month, Cady was selected from 2,400 applicants to be one of 15 mission specialist astronaut candidates. After finishing MIT, Cady received a doctorate in polymer science from the University of Massachusetts, and this background in materials no doubt helped her application to become an astronaut. Cady also holds a private pilot's license, and her hobby is scuba diving. She also volunteers for a centrifuge program at Wright Patterson's Armstrong Laboratory testing G-suits and night vision helmets that are worn by fighter pilots. Cady set an endurance record during one 18-minute spin, staying conscious after all other centrifugees passed out. Actually, Cady had passed out as well, but her experience gained in the MIT classroom of looking awake

Why Wait Until Mid-Life for a Career Change?

Jeff Jimenez's life was changed in a small Greenwich Village cabaret. Until the moment he got up to sing "I'm Just a Small Town Boy" as part of a showcase for students of advanced singing performance at the New School, he thought this was just for fun. He expected to continue working 80-hour, "gung-ho" weeks as a software engineer for a company that packaged databases for the financial industry.

In fact, he had started singing lessons only because he wanted to learn to play the guitar he had picked up for \$10 during a trip home to the Philippines. At the New School, instrumental lessons were free if you were enrolled in voice class. But the song opened up unexpected feelings. "It was the first time I cried on stage," he recalled recently, "a catharsis. My life was busy, but there was a part missing."

That emotional jolt pushed him in a new direction, and in the past two years, he hasn't had time to look back. This spring the 26-year-old starred in *M. Butterfly* at the Palace Theatre in Manchester, N. H., taking the role of Song Liling, the Chinese spy who, disguised as an actress, carries on a 20-year affair with a French diplomat.

Reviews described his challenging, cross-dressed role as "breathtaking."

While he was in rehearsal for that

production, he was also one of close to 1,000 aspiring actors who applied for the Yale School of Drama. Now he is among the 16 students they accepted for the class entering in September.

Growing up in Manila as the fourth of six sons, he played piano, sang, and danced all through high school, yet expected to become a scientist. "Science was a secure profession, one with intellectual rigor. I thought it was through science that I could make my contribution to Philippine society." He had gone to a selective high school modeled on the Bronx High School of Science and says it never occurred to him that an Asian man might make a career in the American theater.

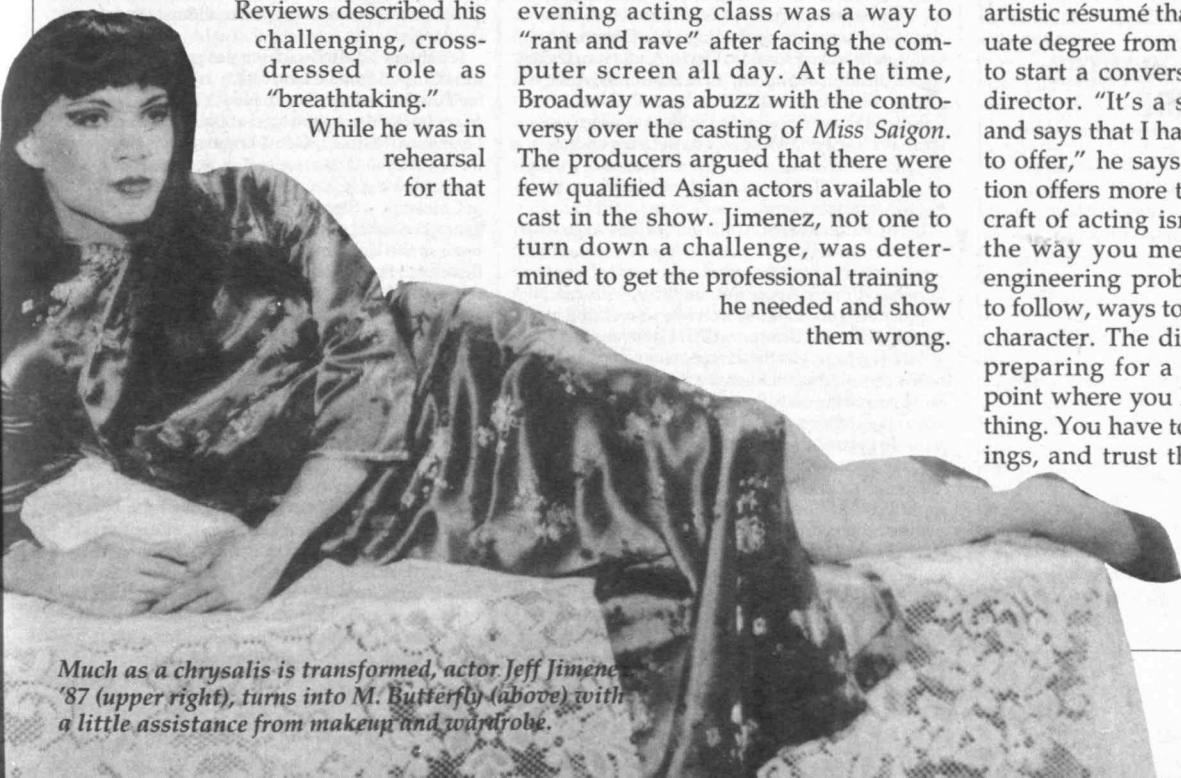
Coming to MIT, Jimenez explored a number of fields. He majored in ocean engineering and worked for Project Athena, but he also plunged into intercollegiate gymnastics—a sport most competitors start as small children—and signed up for an acting class. "I didn't know it would become a passion," he insists, noting that he moved from Cambridge to New York because he'd been offered a good programming job.

Once he settled in the Big Apple, an evening acting class was a way to "rant and rave" after facing the computer screen all day. At the time, Broadway was abuzz with the controversy over the casting of *Miss Saigon*. The producers argued that there were few qualified Asian actors available to cast in the show. Jimenez, not one to turn down a challenge, was determined to get the professional training he needed and show them wrong.

Although Spanish surnames are quite common in the Philippines, Jimenez found that he was called to auditions by people who were expecting an Hispanic actor, not an Asian. So he has taken his mother's maiden name for his stage work. Jesus Feliciano R. Jimenez now appears on playbills as Jeff Ranara.

"Before I was a paid performer, I was cast nontraditionally," he says, (given parts not specifically written for his ethnic group). "These days, if a part is perceived to be Caucasian, I'm just not in the running, and it's difficult to accept that. I'd like to play Romeo, and every actor's dream is to play Hamlet!" But Jimenez sees a long-term benefit. "Minorities can't keep begging for roles that were not written for us. It might serve American theater better if minority artists put energy into creating new works, based on our own heritage."

Jimenez points out that having an artistic résumé that lists an undergraduate degree from MIT has never failed to start a conversation with a casting director. "It's a stamp of legitimacy, and says that I have something special to offer," he says. But his MIT education offers more than credibility. "The craft of acting isn't so different from the way you methodically solve an engineering problem: there are steps to follow, ways to research and build a character. The difference is that after preparing for a role, there comes a point where you have to forget everything. You have to go on pure gut feelings, and trust that the moment will come."—DEBRA CASH



Much as a chrysalis is transformed, actor Jeff Jimenez '87 (upper right), turns into *M. Butterfly* (above) with a little assistance from makeup and wardrobe.

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while being passed out led the experimenters to believe she was still conscious. Yet another of many fringe benefits of an MIT education!

Please send some cards and letters, and we look forward to seeing you at our 10th Reunion.—
Jonathan Goldstein, secretary, c/o TA Associates, 45 Milk St., Boston, MA 02109

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Elaine Lee just finished her first year back at MIT as a PhD candidate in the HST program. She enjoyed the medical school classes but is glad to not have any summer classes so she can relax and focus on her research on the role of vascular smooth muscle cells during heart attacks (i.e., the rupture of atherosclerotic plaques). . . . **Glen Barest**, M.D., is a resident in radiology (a peeping Tom) at Boston City after finishing medical school and an internship in Cincinnati. Glen has a new car (true) and makes house calls (just joking).

Chickie (Teresa) Colucci became certified to teach high school math and French last year. In December, she gave birth to Joe's brother, Anthony Louis. She is looking for a teaching job for the fall having heard that Michigan is the largest exporter of teachers. If this does not pan out she may try to use her previous teaching experience in problem solving, management, and process control to establish something with the education establishment (sounds like a teacher's teacher).

Happy New Year's to all and please write.—
Howard Reubenstein, secretary, 28 Mitchell Grant Way, Bedford, MA 01730, (617) 275-0213 (home), hbr@mitre.org

85

Surprise! Bill is in Japan, so I (**Stephanie Winner**) am filling in for him for the next two columns. Since I have been very negligent in writing Bill about myself, I'll take care of that first. Jeff and I think that daughter Erin (1.75 yr) is definitely going to be an engineer. She won't talk and she has to figure out how all of her toys work. Zoe (5 months) is the socialite. She babbles and smiles all the time. I am still working at Apple as a silicon sorceress in the Advanced Technology Group. The project I work on is for 3D graphics and is called RacerX. In July, we presented our work at SIGGRAPH in Chicago. Jeff is still working at Verity, which is a text retrieval startup. He is the head of the user interfaces group. There are a lot of other alums working there including Mike Cation, Abe Lederman, Mike Frumkin, David Anderson, Dave Glazer, Anders Wallgren, Mike Edmunds, Alice Chang, Cliff Reid, and Phil Nelson. Phil is a founder and is now working in the kernel group. Phil says Verity had its best quarter ever ending last June. Phil is married to Quee (Beeman). Quee is working on a PhD in philosophy and they are living in Mountain View.

Libby Patterson left Apple in February to go work for General Magic in Mountain View. I know she is working really hard because I can never get a hold of her! Even though Apple lost one '85er, we hired another last July. **Charley Selvidge** is working in the System Software Group in ATG. He finished a PhD at MIT last June. His thesis topic was compilation-based prefetching for memory latency tolerance. He will be working on software techniques to take advantage of high-performance and parallel systems. In his free time he enjoys rock climbing, camping, skiing, waterskiing, and scuba diving.

Jim Lutz returned to the States for several months while he was working in NYC. In September, he returned to Tokyo and is now working for Tekntron. On his way back to Japan he stopped in Palo Alto and we got together to catch up. In the summer of '91 he married Masako in Japan. Last May 20th she had a baby girl, Eleanor Kaori Lutz. . . . **Anna Lisa Fear** and her husband, John Goodwin, bought a house in Oakland last November. Anna

survived the Cetus merger with Chiron and spent 12 weeks in France transferring the technology that she had been working on. For the first few weeks she had a apartment four blocks from the Louvre. After returning in July she travelled to Oregon twice and Michigan once! . . . **Dan Weidman** is continuing to work on PhD research in physics at the Naval Research Lab in D.C. He says he sent in the puzzle solution to one of the infamous *Tech Review* puzzles. Please send your news to Bill! I'll be thinking of him as winter sets in at CMU...br...—
Stephanie Winner, acting secretary filling in for: **Bill Messner**, secretary, 8 W. Winkley St., Amesbury, MA 01913

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Slow news month, so I may have to improvise. I actually received no letters this month, so PLEASE WRITE!

Eddie Gornish and **David Marcovitz** are out at the University of Illinois in Champaign-Urbana. Eddie is working on a PhD in computer science and David is working on a PhD in education. . . . **David Brown** is working for ESL in Sunnyvale, Calif. He belongs to a hockey league out there and plays on an all MIT line.

Rick Russell—another year passes and another Beaver Cup is won by the MIT alumni. Once again, people came to L.A. from all over the country to play ice hockey against CalTech. MIT won 2-1 in the closest game to date. . . . **Ed Mount** has been living in Switzerland for almost two years, working for O'Connor & Associates along with Swiss Bank Corp. He's doing portfolio management in foreign exchange options. . . . **Paul Laferriere** left the Air Force in 1991 and, after traveling some, moved to Sunnyvale, Calif. Nine months later he's back in Cambridge working for a small office of Panasonic right in Kendall Square. He now lives up the red line in Porter Square. Paul wants to know if there's anyone in the Boston area who needs a doubles volleyball partner. . . . **Martha McKinney** graduated in May with an MD from Bowman Gray School of Medicine and moved to Vancouver to begin her internship.

I regret to inform the class that one of our classmates has passed away. **Paul Ramos** died in May from injuries sustained in an automobile accident. He is survived by his wife and daughter. . . . I talked to **Greg Harrison** recently. In addition to working for the Jet Propulsion Lab, Greg is taking classes at UCLA in standup comedy. He is scheduled to perform at the Improv in Santa Monica, Calif., on Labor Day. He's come a long way from the Air Force life.

Jehanbux Edulbehran is a design engineer for Intel Corp in Santa Clara, Calif. . . . **Jim Egan** works for Turner Construction in New York City. . . . **Mary Lockshin** is a scientist at Polaroid Corp. in Lexington, Mass. . . . **Geoff Engelstein** is the director of CAD/CAE services at GR Technical in Mountainside, N.J. . . . **Jim Errico** is with Motorola in Chicago. . . . **Stanley Etra** is with Artificial Intelligence Tech in Hawthorne, N.Y. . . . **Laura Fainsilber** is at the Universite de Franche-Compte in Besancon, France. . . . **Anna Fear** is a research assistant with Chiron Corp. in Emeryville, Calif. . . . **Jene Ferrarer** is a manufacturing engineer at Lockheed Aeronautical Systems Co. in Inglewood, Calif. . . . **Tom Fitzpatrick** is a senior hardware engineer at DEC in Maynard, Mass. . . . **Richard Fleischner** is with the Jet Propulsion Lab in Pasadena, Calif.

Richard Flores is a trader with Salomon Brothers in New York City. . . . **Gail Flowers** is with Honeywell-Bull in Billerica, Mass. **Dara Foias** is a development engineer with Hewlett-Packard in Santa Clara, Calif. . . . **Leonard Foner** works for Bitstream, Inc., in Cambridge, Mass. . . . **Tom Forest** works for Jump-Start Management Systems in Medford, Mass. . . . **Andrew Fraley** also works for Hewlett-Packard, but in Roseville, Calif. . . . **Debra Friedman** is a senior software engineer for Mammoth Micro Productions Inc. in Golden, Colo. . . . **Myles Friel** is with AMB Instruments in San Fran-

cisco. . . **Marc Friend** is a research associate with Charles River Ventures in Boston. . . **Hishashi Fujinaka** is in product marketing with Tektronix in Beaverton, Ore.

Peter Ulrich is a flight instructor for the Navy in Beeville, Tex. . . **Evelyn Vance** is at the Center for Naval Analyses in Alexandria, Va. . . **Roy Vandermolen** is an engineer at the Oak Ridge National Lab in Oak Ridge, Tenn. . . **Linda Van Duyn** is an engineer at EVS Engineering Services in Salem, Mass. . . **Jeremy Verba** is an analyst at First Boston in New York City. . . **Frank Verhoorn** works for Intel Corp. in Hillsboro, Ore. . . **Michiel Vermeulen** is a software engineer for Hewlett-Packard in Fort Collins, Colo. . . **Susan Visser** is a research scientist with Eastman Kodak in Rochester, N.Y. . . **Susana Vogeler** is an engineer in the industrial policy division at the Compagnie de Saint Gobain in Paris, France. . . **Sonya Vogtmann** is still working for the Air Force in Los Angeles.

I don't really like to resort to the alumni listing, so again, please write!—**Mary C. Engebret**, secretary, 1805 Manhattan Ave., Hermosa Beach, CA 90254, (310) 376-8094

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Lots of news to report this month! **Laura Kotovsky** checks in from the University of Illinois in Urbana/Champaign, where she is working on a PhD in developmental psychology. She got married last August to Ran Libeskind-Hadas. "He graduated in 1987 from Harvard, but believe it or not, we met here in Champaign and not in Cambridge. . . My two MIT roomies are doing well. **Joyce Licini** is working for Lotus in Cambridge and is engaged to Mike Vigneau. **Patti Lodi** received a PhD in chemistry from Harvard this year and is now a postdoc at the NIH. . . Also from Burton 2, **Eli Niewood** is married to Joyce Kamens. They had a healthy baby boy this summer, Benjamin Zachary. Eli is working on a PhD at MIT in the Aero/Astro Department. . . **Daniel Saal** is working on an MD and a PhD at Yale. In his spare time, he sings in a Russian Chorus at school." Thanks for that update, Laura!

From the heart of Silicon Valley. . . **John Eisenman** has been working for Silicon Graphics for the past four years and is surrounded by many other MIT alumni, including housemate Chuck Rosenberg, '89. John writes that he spent a month in Tokyo last year, where he saw Cary David, '88, and Pat Nee, '88. Last summer, he attended **Kay Lin's** wedding (send us details, Kay!). . . **Tom Abell** is returning to MIT to attend the Sloan School after spending the past few years at Ford. . . Also in B-school is **Ojas Rege**, who has been attending Stanford for the past year.

Stephanie Levin, our former class secretary (and new class president) sent a quick note. She and **Jim Koenig** were engaged on July 3 in New Orleans during a surprise trip. The funny part is that they never knew each other during their four years at MIT! She also writes that **Hal Cohen** and **Julie "Spit" Temple** are recently engaged.

I recently saw **Jerry Hershkovitz**, who is relocating to Austin, Tex. He tells me that after two years in Israel, he's glad to be back in the States working (again) for Motorola, as a chip designer. During his job search, Jerry ran into helpful alumni/ae including **Jon Root** and **Michele Bonugli**, '88 (Boston), **Mike Liebson**, '86 (Chicago); **Frank Verhoorn**, '86, **Steven Blacker**, SM '88; and, of course, the New York City Young Alumni Clubbers (**Andy Muenz**, **Stephanie Levin**, **Jim Koenig**, **Hal Cohen**, **Jay Cohan**, and **John Kenny**, '86).

Patricia Lee Obermaier received an MBA from the University of Virginia at Charlottesville. She will be working in Reston, Va., as a senior manager with Pracon, Inc. . . **Mark Harysch** married Sheryl Staley on June 22, 1991. Mark is stationed at Loring Air Force Base in Caribou, Maine, and flew last year during Operation Desert Storm.

For those of you who don't know, elections were held at the reunion Sunday brunch, and Class of '87 now has a fresh slate of officers (including me, your

new class secretary). By way of introduction, I am currently trying to finish my dissertation at the University of Texas at Austin, where I am developing new mechanical tests for TAB integrated circuits. As for who the rest of the officers are and what they are doing, stay tuned for next month's column. Until then, keep those letters, phone calls, and e-mail messages coming!—**Jack Leifer**, secretary, 2703 Swisher St., #202, Austin, TX 78705, (512) 472-7507, e-mail: leifer@ccwf.cc.utexas.edu

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Please send news for this column to: **Grace Ma**, secretary, 19 Candlewood Rd., Lynfield, MA 01940

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Please send news for this column to: **Henry Houh**, secretary, 4 Ames St., Cambridge, MA 02142, (617) 225-6680, e-mail: tripleh@athena.mit.edu or henry_houh@mit.edu

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Hello everyone! Only six letters over the summer months. I'm hoping this means everyone is saving their juicy news for the next issue!

David Plass, who is working in New York, visited **David Martin** in Boston over the July 4th weekend. David is a graduate student at MIT in Course 6. Word has it that the view of the fireworks from MIT was spectacular. . . **Michael Jemiolo** writes that after working for one year in Chicago, he accepted a two-year assignment in Singapore. There he is the trader and risk manager of options on Japanese yen in Asia for Swiss Bank Corp. Michael finds Singapore a lot of fun and has been taking advantage of the location to travel. A couple of his travel highlights include going on elephant safaris in Thailand and skiing in Japan.

Congratulations to **Ron Logan**, who was married June 20 to **Julie Fernandes**, a California State University graduate. Their wedding was held in a small church in Tres Pinos, Calif., about an hour south of San Jose. **Robert King** was the best man and **Michael Gesner**, '89, flew out from Florida to be a groomsman. Also attending the wedding were **Scot Griffin** and his girlfriend. Now Ron and Julie are living in Sacramento, and Ron is working on a master's in computer science at California State University, Sacramento and working as a computer programmer for the California Department of Forestry. Julie works for a public relations firm in downtown Sacramento. Scot has finished the second year of law school in San Francisco; Michael is a jet engine guru for Pratt and Whitney; and Robert is a senior associate engineer at Lockheed Missiles and Space in Sunnyvale, Calif.

Second Lieutenant **Time Townsend** sends his greetings from Dayton, Ohio. In June, he and **Stephanie Patterson** held a small MIT alumni/ae barbecue at Stephanie's place. In attendance were fellow Air Force officers **Steve Peltzman**, **Andrew Knoedler**, Teri Center, '89, **Rob Bergevin**, '89, **George Dyer**, Oliver Patterson, '85, **Rich Fletcher**, '88, and **Vic Christianson**, '87. Special guest was Captain **Charles Barondes**, a former MIT AFROTC instructor. Everyone compared notes on their Air Force experiences and had a great time!

Anthony Lujan is back at school working on a PhD in nuclear engineering at the University of Michigan, Ann Arbor. Anthony spent two months this summer in Japan. In Ann Arbor, he shares an apartment with **Alex Chen**. . . In late July, **Desmond Davis** was once again vacationing in the Big Apple. This time he was taking a short break before beginning his new assignment in Dallas for McKinsey & Co. Desmond had a chance to check out the newly renovated Guggenheim Museum and meet up with other MIT alums for a night out

5th Reunion

on the town! Among the people he saw: **Feroze Deen**, who recently got a master's from Stanford and is now working for Mercer Management Consulting in Manhattan.

That's it for this issue. Please take a couple of minutes and write in. Let's all keep in touch! Send news to **Ning Peng**, secretary, 305 Memorial Dr., Cambridge, MA 02139

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"Alaska is swell!" writes **Anne Sammis**, "See mountains, bears, tundra, and more!" Anne lives in Anchorage, Alaska, and works for Livingston Slone, Inc., Architects. She has had a few visitors, including **Christina Friedrich**, who now works for Oracle in San Francisco, **Patt Maier**, '88, **Annabelle Boyd**, '90 and **Margaret Tawadrous**, '90. . . **Charon Gwynn** planned a September visit "to do the camping/backpacking/kayaking thing." Charon will attend NYU to get a PhD in environmental engineering. . . **Shanna Kovalchick** is working as an architect and civil engineer for a firm in Vail, Colo., and **Alyssa Parker** works as an architect there as well.

"I graduated with a master's (co-op) this June in materials engineering," writes **Julie Gupta**. "After graduation, Kathy Nothnagle, '92, and I drove cross-country and back. We drove down through DC to Atlanta, saw Graceland in Memphis, then went through Sante Fe to the Grand Canyon. We hiked the canyon! After Yosemite, we went to San Francisco and got together with **Angela Roberts**, who is engaged and will be getting married next summer. Her fiancé works at Oracle. We stayed with her and also got together with **Rob King**, '90, **Mike Gesner**, '89, and **Vivek Rastogi**, '90. On our way back to the East Coast, we stopped in Ann Arbor, Mich., and saw **Christine Reynolds**, who is getting a master's in environmental engineering at the University of Michigan. We went through Toronto and saw **Ferace Rammo**, '90, who is working at Com Dev in Ontario." After Kathy and Julie returned, they set to work—Kathy at Mobil Chemical in Rochester and Julie at Bain & Co. in Boston.

Sharra Davidson is attempting to set a new record for longevity for an MIT alumni/ae in the George Bush camp. She was the budget director for campaign management and coalitions for the Bush campaign and also worked at the Republican convention. Sharra sends news about other classmates: **Brian Katz** married **Sue Powell**, '92, in Laconia, N.H., on August 9. . . **David Rothstein** has completed EMT training and is performing biology research at Baylor. . . **Monica (O'Connell) Niles** is working at MIT's Admissions Office as an admissions counselor. . . **Rene Agarwala** is in Waltham, Mass. . . **Sue Perrin** is living in New Haven after returning from a tour of Europe. . . **Jeanne Druding** was in Kansas, but is now working for Air Products in Allentown, Pa. Sharra saw Jeanne and several other AXO's at a surprise party to celebrate **Debbie Schneck's**, '89, engagement.

Peter Stewart, **Paul Borghesani**, **Michelle Leong**, and her fiancé, **Cliff Schmidt**, '93, along with a gaggle of other Phi Sigs and their friends, celebrated a rainy July 4th weekend with me on Squam Lake in New Hampshire. Peter and Paul both waterskied for "the longest time ever," and we also hiked up Mount Moosilauke to enjoy a panoramic (and windy) view of the White Mountains.

It seems I always run into classmates the week I need to do this article. During a softball game at MIT, I talked with **Dinesh Tummala** after one of us hit a single and the other was playing first base. Dinesh is doing graduate work at MIT. Then on my way home to write this article, I saw **Dave Borison** on the Green Line. Dave is working for Anderson Consulting and was married in August.

Now that winter is setting in, I'm looking forward to postcards from your autumn tours and learning about all of your new adventures and activities. Please write to: **Andrew Strehle**, 12 Commonwealth Ct., #10, Brighton, MA 02135, (617) 232-2261

I CIVIL ENGINEERING

Nick Stathakis, SM '88, sends word from Athens, Greece: "After graduating from MIT with a master's degree in construction engineering and management, I worked for three years at Stone & Webster (engineering and construction firm) in the project management area. I returned to Athens to fulfill my military obligations. Currently, I am working as a senior management consultant at Forecast LTD (a market research and management consulting firm) and at the same time I am the managing director of my family's importing and trading business."

Mention of **Juan Antonio Poblete**, SM '69, in the July 1992 column failed to mention the name of his Santiago, Chile-based consulting firm. It is Ingeniería de Gestión Ltd. . . . **Giorgio Bugliarello**, ScD '59, president of Polytechnic Institute of New York, has been named to the board of directors at Symbol Technologies, Inc., in Bohemia, N.Y.

Rafael L. Bras, '72, SM '74, ScD '75, an internationally respected authority in hydrology, has been appointed head of MIT's Department of Civil Engineering. He succeeds **David H. Marks**, who has headed the department since 1985. Marks was recently appointed to direct the School of Engineering's newly established Program in Environmental Engineering Education and Research. Bras, who has been a member of the faculty since 1976 and who holds the William E. Leonhard Professorship of Engineering, has specialized in the interpretation of natural phenomena as random functions. He has been recognized for his use of modern probabilistic methods in the design of networks to monitor rainfall and river flow, and in rainfall and river discharge forecasting. His present interests focus on fluvial geomorphology and hydroclimatology. From 1983-91 Bras was director of MIT's Ralph M. Parsons Laboratory for Water Resources and Hydrodynamics and headed the Water Resources and Environmental Engineering Division of the civil engineering department. Bras, who holds a joint academic appointment in Course XII, is also associate director of the Center for Global Change Science.

Yasuo Mori, SM '68, and **Keizo Hatta** are the editors of *Global Environment Protection Strategy Through Thermal Engineering* (Hemisphere, 1992). The book contains papers from the final report of the research subcommittee in the thermal engineering division of the Japan Society of Mechanical Engineers. Mori is associated with the Tokyo Institute of Technology.

John Carlson of Winchester, Mass., died unexpectedly on June 25, 1992, after completing a lecture at Princeton University. Carlson was a Course I lecturer in the Center for Construction Research and Education at MIT. He was appointed commissioner of the Massachusetts division of capital planning and operation by then-Governor Michael Dukakis in 1986. Prior to that, he was the president and CEO of Carlson Group, Inc., in Cohasset, Mass. Since 1974, Carlson had served on the New England Deaconess Hospital board of trustees. He was also a member of the Building Futures Council, the Associated General Contractors, and the Boston Society of Architects.

II MECHANICAL ENGINEERING

From Delmar, N.Y., **Joseph K. Ting**, SM '74, writes: "On June 30, 1992, I completed my term as president and chair of the board of ASHRAE's Northeast Chapter. In April 1992, I was named to Who's Who in Environmental Registry by Citation Directories, Ltd." . . . **P. Ranganath Nayak**, SM '65, ME '67, ScD '68, a senior VP of Arthur D. Little, Inc.,



P.R. Nayak

has been elected to serve a two-year term on the international board of directors of The Planning Forum, a society for strategic management and planning based in Oxford, Ohio. Nayak, who oversees ADL's corporate marketing and its worldwide operations management consulting practice, has more than 22 years of experience in R&D, manufacturing, and consulting.

Before joining ADL, he was employed by Tata Engineering and Locomotive Co., Ltd., India's largest automotive manufacturer. **Hjalmar (Ham) D. Bruhn**, SM '37, was presented the 1992 McCormick-Case Gold Medal by the American Society of Agricultural Engineers. The Cyrus Hall McCormick/Jerome Increase Case Gold Medal recognizes "exceptional and meritorious engineering achievement in agriculture." Bruhn was honored for engineering achievements in forage processing, and for his professional influence on his students. Despite his "retirement" 13 years ago, Bruhn continues to work daily in the University of Wisconsin's Agricultural Engineering



H.D. Bruhn

Department. In 1970 Bruhn received the Polygon "Outstanding Instructor" Award for his teaching excellence and the inspiration he imparts to engineering students. His pioneering research on agricultural machinery has led to significant applications in many areas such as the mower-conditioner used in forage processing, invention of the mechanical tree planter, well drilling and sprinkler irrigation, mechanical fruit harvesting, and aquatic vegetation harvesting. Bruhn continues to play an important role in helping to adapt the weather-independent forage harvesting process in protein extraction. Equipment developed by Bruhn is currently being used by a number of Mexican villages for nutrition improvement and has brought him international recognition for benefiting third world developing countries.

Subra Suresh, ScD '81, professor of engineering at Brown University, is a co-recipient of the 1992 Ross Coffin Purdy Award from the American Ceramic Society, Inc., for a paper titled "Tensile Fracture Toughness of Ceramic Materials: Effects

of Dynamic Loading and Elevated Temperatures." The award is given to the author or group of authors who, in the judgment of the award committee, made the most valuable contribution to ceramic technical literature during the calendar year prior to the selection. Suresh, appointed to the Brown faculty in 1983, is the author of *Fatigue of Materials* and a frequent reviewer for engineering journals. . . . **Ain A. Sonin**, Course II professor, is one of the first recipients of the Ruth and Joel Spira Award for Teaching Excellence. The \$1,000 awards were established a year ago by Joel and Ruth Spira. Their daughter, Susan Hakkarainen, PhD '89, and son-in-law, S. P. Hakkarainen, PhD '88, both received doctorates in Course XXII. Sonin is a senior faculty member who has served as graduate officer for mechanical engineering and as chair of the department's Graduate Policy Committee. He is most widely recognized for teaching Advanced Fluid Mechanics, the first-level graduate course in fluids. Academically challenging, the course consistently draws between 60 and 90 graduate students, making it the single largest graduate subject in the Course II curriculum.

Tan Chih Lu, SM '44, of Tustin, Calif., died on June 2, 1992. He retired from Rockwell International six years ago at the age of 70, after 27 years of employment. . . . The Association of Alumni and Alumnae has been notified that **William A. Williams**, SM '36, died on February 4, 1990. No further information was provided.

III MATERIALS SCIENCE AND ENGINEERING

Institute Professor **John S. Waugh**, ScD '60, has been presented the William Richards Medal by the Northeast Section of the American Chemical Society for "pioneering work in nuclear magnetic resonance spectroscopy." The award is made biennially in recognition of conspicuous achievement. . . .

John B. Vander Sande, the Course III Cecil and Ida Green Distinguished Professor, has been appointed the associate dean of MIT's School of Engineering. Vander Sande's areas of expertise include observations of the structure of materials, particularly metals and ceramics, through the use of various forms of electron microscopy and performing research on the relation between the way in which a material is processed and the structure and properties it exhibits. Along with research on iron-based and aluminum-based alloys, he has also been deeply involved in the new high-temperature superconducting oxides discovered in 1986. Vander Sande chaired a committee responsible for constructing and implementing the present undergraduate curriculum in his department. In addition, he has represented the department on the School of Engineering Education Committee for the past year. . . .

Edward A. Bryan, '55, operates a technical translation service in Philadelphia. A staff of eight engineers and scientists provide translations of German, French, and Russian engineering and scientific material. He can be reached at 215-952-6063.

Michael B. Bever, SM '42, ScD '44, of Cambridge, died August 17, 1992. Bever was a retired Course III professor and a pioneer in the scientific study of recycling. In 1972 he won an award from the National Association of Secondary Materials for his development of the first integrated scientific

approach to recycling. In the field of metallurgy, he introduced the application of thermodynamics to the mechanical properties of metals. He was also a leader in the use of calorimetric techniques to explore the energetics of the ordering of atoms in crystalline structures. Bever was a Fellow of the American Academy of Arts and Sciences, AAAS, and ASM. He was also an overseer of the Boston Museum of Science.

IV ARCHITECTURE

From Brownsville, Vt., **Steve Pieper**, SM '89, PhD '92, reports: "I am an assistant professor of engineering at the Thayer School of Engineering at Dartmouth College. I am also a co-founder of Medical Media Systems, a start-up medical imaging firm." ... From Vancouver, B.C., **John B. Davidson**, MAR '71, writes:

"Davidson/Yuen/Simpson Architects has a staff of 50 involved in major urban redevelopment—Expo 86 lands and moderate income housing of approximately 6,000 units. We also do recreational/retirement community planning and development. Our Toronto office opened in 1992 with a 1,500 unit waterfront project." ... Word from **Peter Droege**, MAA '78: "I am now the advisor for urban development and design to the city of Amsterdam. My office is with the urban planning department and my primary foci are large-scale inner-urban development along the city's northern waterfront, and a new community of 50,000 on to-be-claimed land just east of the city center. I work on urban design concepts, urban quality planning, the formulation of city design and development policy, and institutional adjustment strategies. I accepted an offer by the University of Tokyo to fill the prestigious Urban Development Engineering Endowed Chair in the Research Center for Advanced Science and Technology. My residency commenced in August, following that of Peter Bosselmann of U.C. Berkeley. I plan to investigate East Asian urban form changes under the influence of the late '80s' offshore investment wave."

Belinda Walters, SM '86, was recently wed to Donald Roy Hootstein. She is employed at Forest City Development and her husband is VP of Group Four Design in Avon, Conn. ... **Armand Feigenbaum**, SM '48 (XV), PhD '51, president and CEO of General Systems Co., received an honorary doctor of science degree from Union College, his undergraduate alma mater. The college said the degree recognizes Feigenbaum's contributions to corporate quality for nearly a half-century, first as manager of manufacturing and quality control at GE and then as president and CEO of General Systems, working with many of the world's leading businesses. ... Professor **Richard H. Adelson** of the Media Lab and Course IX will share the 1992 Rank Prize for Opto-electronics. The award recognizes Adelson's and colleagues' investigation of how the brain processes visual information and their elucidation of the mechanisms of motion perception. The prize, established by the late Lord Rank, a leading figure in the British film industry, was presented at the Royal College of Surgeons in London.

William J. Mitchell, former director of the Master in Design Studies Program at Harvard University, was named the dean of the School of Architecture starting July 1, 1992. Mitchell succeeds **John de Monchaux**, who served as dean for almost 11 years and will remain at MIT as a Course IV and XI professor. Mitchell, like de Monchaux, hails from Australia. Prior to Mitchell's association with the Graduate School of Design at Harvard in 1986—where he held the G. Ware and Elythe M. Travelstead Professorship in Architecture—he was on the faculty at the University of California at Los Angeles, where he was head of the Architecture/Urban Design Program from 1980–86. He also has been a visiting professor or scholar at a number of universities including Cambridge, Carnegie-Mellon, and the University of California at Berkeley. His scholarly interests include design theory, computer-

aided architectural and urban design, and electronic media, and he has been active as a researcher and practitioner in these areas. He has written five books; the most recent, *The Reconfigured Eye: Visual Truth in the Post-Photographic Era*, was published by MIT Press this past fall.

V CHEMISTRY

Stefan H. Unger, PhD '71, writes: "I am VP of marketing for Oxford Molecular, Inc., a biotechnology and molecular modeling software company. OMI commercializes the best academic software on an international basis." ... **Virginia R. Cross**, PhD '76, reports: "I was promoted to senior staff chemist this year. I'm working on polymerization catalysis for Exxon Chemicals." ... U.S. Representative **John W. Olver**, PhD '61 (D-Mass.), delivered the main address at Holyoke Community College's commencement this past June. He was also presented with the college's Distinguished Service Award for promoting the cause of education and for emphasizing scholarship and learning. ... **Steve Rokita**, PhD '83, a researcher in the Department of Chemistry at the State University of New York at Stony Brook, has been awarded a grant by the Seed Grant Award Program run by the Center for Biotechnology at Stony Brook. The center's seed grant program, designed to support innovative medical biotechnology research in its early stages, is open to researchers from institutions across the state. Rokita's project is called "Chemotherapeutic Alkylating Agents Activated by Their Biological Targets."



Nancy Harrison Kolodny, PhD '69, was appointed dean of Wellesley College this past July. Kolodny is an internationally recognized authority on nuclear magnetic resonance and its implications for the diagnosis and treatment of eye disease. She was a research fellow in medicine at Harvard Medical School and the Massachusetts General Hospital from 1971–72.

N.H. Kolodny

From 1970–72 she was a Bunting Fellow at Radcliffe College, and her work in the field of NMR has been supported by the American Diabetes Foundation, Lion Club International, the National Eye Institute, Research Corp., and the NSF, among others. In 1992 she received a Guggenheim Fellowship in support of her work on magnetic resonance studies in ocular physiology. In conjunction with another colleague, Kolodny administers a project supported by a grant from the Sloan Foundation for research on factors that influence women to pursue careers in science. A member of the Wellesley faculty since 1969, Kolodny was co-director of the Computer Literacy Project, director of the Science Center, and served on the committee on Faculty Appointments.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Daniel N. Jackson, SM '88, PhD '92, writes: "I completed a PhD last July and we moved to Pittsburgh, where I am assistant professor of computer science at Carnegie Mellon University." He and his wife, Claudia, were expecting a baby at the end of August as of this writing. ... **Isaac M. Horowitz**, '48, is the recipient of the Rufus Oldenburger Medal established in 1968 by ASME. It is awarded to an individual in recognition of meritorious contributions to the field of automatic control. Horowitz was cited for "outstanding leadership and contributions in the design of feedback control

systems having significant parametric and non-parametric uncertainty, for conceiving and developing the quantitative feedback theory design method, and for exemplary leadership in feedback control education." ... **Thomas F. Weiss**, SM '59, PhD '63, an expert in signal processing in the auditory system, has been named the first holder of the Thomas and Gerd Perkins Professorship of Electrical Engineering. **Thomas Perkins**, '53, a venture capitalist, owns Kleiner Perkins of San Francisco, and has successfully launched several new companies. He is the only person in history to have been chair of three companies listed on the New York Stock Exchange. The Perkinses are avid sailors and once crossed the ocean in only 11 days. The chair was established to advance the fields of electrical engineering, with initial emphasis on areas of potential importance to human health. Weiss has been responsible for the development of a subject, Quantitative Physiology: Cells and Tissues, which is both part of the Harvard-MIT Division of Health Sciences and Technology and the first in a series of bioengineering subjects for the department's bioelectrical engineering option. One of the most active users of Project Athena for educational purposes, Weiss won the nationwide 1990 EDUCOM/NCRIPAL Higher Education Software Award for the best engineering software. Perkins joined the MIT faculty in 1963 and holds appointments at Harvard Medical School and the Massachusetts Eye and Ear Infirmary.

Lynn A. Stein, a member of the Course VI faculty since 1990, has received a \$25,000 Junior Faculty Career Award from the School of Engineering under a new program supported by the GE Foundation. The foundation's Faculty for the Future program is designed to increase the number of women and members of underrepresented minority groups on the engineering, science, and business faculties in the United States. The foundation has committed \$330,000 over three years to MIT. Stein is working in two areas. She is interested in making computers behave intelligently and support human cognition and in designing and using inexpensive interactive robot agents to explore the relations between behavior and cognition. ... **Elias P. Gyftopoulos**, ScD '58, the Course XXII Ford Professor of Engineering, was named the outstanding professor by the American Nuclear Society Student Chapter. ... **Martha L. Gray**, SM '81, PhD '86 (HST), the J.W. Kieckhefer Assistant Professor of Electrical Engineering, is one of the first three recipients of the Ruth and Joel Spira Award for Teaching Excellence. The \$1,000 awards were established a year ago by Joel and Ruth Spira. Their daughter, Susan Hakkarainen, PhD '89, and son-in-law, S. P. Hakkarainen, PhD '88, both received their doctorates in Course XXII. Gray holds a joint appointment in Course VI and the Harvard-MIT Division of Health Sciences and Technology and, according to Dean of Engineering Joel Moses, PhD '67 (XVII), "has distinguished herself both by her research and by the breadth and quality of her teaching. Her principal HST teaching responsibility has been Renal Pathophysiology. Within EECS, she has taught recitation sections in the common-core subject on linear systems. To paraphrase one of her colleagues, Gray can do kidney function for medical students one term and Fourier transform for engineering the next."

Nesbit L. Duncan, '49, of Belmont, Mass., died on June 15, 1992. Duncan was a retired engineer for the Air Force who was awarded the Bronze Star for valor at the landing at Anzio. After his war service, he worked for Raytheon as a research engineer in guided missile technology. He then joined the Air Force as a civilian engineer and worked until the late 1980s. During that period, he was loaned to the Dutch government and worked in Holland from 1964–66. During the war he was also assigned to teach radar technology to French officers. ... **Jack Delmonte**, SM '34, of Glendale, Calif., died on April 15, 1992. After starting to work as a test engineer at the U.S. Naval Aircraft Station in Philadelphia, Delmonte became interested in newly developed plastic materials. He began writing articles about this new field and wrote one of the first text-

Packing Airspace

This is the captain speaking," the intercom announces to a plane full of impatient passengers. "Because of delays at our destination, we will not be taking off for another 45 minutes."

Sound familiar? Probably, if you've flown at all in the last few years. An increasing number of airports are being used beyond the capacity for which they were designed, making delays more and more frequent. But Professor of Civil Engineering Robert Logcher, '58, may have found an answer to the problem: dynamic flight planning—changing flight plans while airplanes are already in the air—with the help of computers.

The systems now used by the United States, Japan, and other developed countries call for flight plans to be updated as often as every 15 minutes by a central authority, based on reports from regional airports. But those updates only reflect airplanes on the ground—once a jet is in the air, the pilot is no longer under the controllers' authority.

Under the sponsorship of Japan's NTT Data Communications and Systems Corp., a subsidiary of Nippon Telephone and Telegraph, Logcher devised Intelligent Air Traffic Routing (IATR). Instead of looking at individual aircraft and airports, as human air-traffic controllers do, IATR constantly scans the system as a whole. Its decisions are geared to making the overall system more efficient, rather than helping a single plane get to its destination faster. The results of this global analysis are then individualized, with a steady stream of directives for each of the system's elements. "We constantly track the aircraft from take-off and adjust each plane—tell

the aircraft to slow down a little bit, or hold the plane at high altitude [so that it arrives exactly on schedule]. What we're trying to do is take the variance out of the operations process," says Logcher.

One of the most significant advantages of automated routing would be the greater density with which airplanes could be packed—up to 25 percent greater, according to Logcher. Today's air traffic contains much "wasted airspace, because controllers separate airplanes against 'walls' when in fact there's no aircraft on the other side," says Lawrence G. Culhane, an associate technical director in the MITRE Corp.'s Center for Advanced Aviation System Development. "It's only that way because we don't have sufficient sensors and automation capability." Adding computers and sensors to the system would eliminate the need for these "walls" (and "ceilings") of empty space between adjacent aircraft, make it easier to keep track of aircraft, and ensure passenger safety while at the same time improving the traffic flow.

Such a system is also under consideration in the United States, says Culhane, who is the chair-elect of the Air Traffic Control Association. Automated En-Route Air-Traffic Control (AERA) is the FAA-sponsored project to bring traffic control into the 1990s, and Culhane expects it to "change air-traffic controllers from being second-by-second, minute-by-minute manipulators into strategic monitors of the overall process."

A major difference between conditions in Japan and the United States, Logcher reports, is the non-controlled traffic in

American airspace from the increasing number of private planes. Because Japan has so little non-controlled aircraft, Logcher says, the system he designed for NTT isn't required to take this additional traffic into account.

Experts disagree on just when we can expect these improvements in operation. "Changes in air-traffic control take probably 10 years from the time you plan a system change to the time of production," Logcher says. And that's an optimistic forecast.

"If you look at our current air-traffic control system in this country," he adds, "a large part of it is still using vacuum-tube computers." Some of the computers are so old that airports are unable to find spare parts, such as magnetic core memory, that have not been manufactured in nearly 30 years.

Culhane, while agreeing that today's aircraft do not contain as much modern equipment as they could, has a rosier view about the FAA's modernization plans. "All of the air-traffic control computers, displays, and software in the United States will be replaced in the decade of the '90s," he maintains.

Safety also figures into the long delay. Controllers in any country become comfortable using a certain set of controls in certain ways. Before changing to a new system, Logcher said, you want to make sure that controllers "know exactly what to do, how to do it, and have the confidence to make decisions well without endangering safety."

—REUVEN M. LERNER, '92 (The author is completing an SB in computer science and engineering and served as editor of The Tech.)

Hi, this is your pilot. We're something like 124th in line for takeoff. So I'm going to pull out to the left rather quickly, press the pedal to the metal and get to the front of the line and take off before anyone knows what's happening... Are you with me?



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books on the subject: "Plastics in Engineering," which was printed for three editions. Delmonte lectured on plastics at the Illinois Institute of Technology after his daytime job at the Sunbeam Electric Co. In 1940 he began a 10-year stint as director of the newly formed Plastics Industries Technical Institute, where he wrote the course of study. In 1946, after developing a unique polymer material, he started his own company, Furane Plastics, Inc., in Los Angeles. The company was successful as a plastics supplier, but the company was sold to American Can Co. in 1972 when Delmonte became ill. After recovering his health, he worked for Delsen Testing Laboratory, an independent lab that he founded. In 1976 he was honored by the Society of Plastics Industry and was elected to its Hall of Fame. Delmonte will most likely be most remembered for his generous contributions to scholarships. He initiated programs to honor students and teachers. He set up an adopt-a-school program, in which businesses help schools. For the last five years, Delmonte and his wife also gave scholarship money for a presidential task force that selects the top math and science teachers from each of the 50 states.

VI-A INTERNSHIP PROGRAM

It's currently August 3, the deadline for this article, and the superb July 11-15 display of Tall Ships of "Sail Boston 1992" is over. To one who can recall three-and four-masted schooners plying our north-eastern coast, it was a touching remembrance of years gone by and a wonderful review of the many types and rigs of these majestic vessels.

I hope you all saw Editor Emeritus John Mattill's article on VI-A's 75th anniversary, in the October issue of *Technology Review*. One hundred thirty signed up for selected events of the two-day celebration. They comprised 67 alumni/ae, 53 non-alums, and 10 staff. Very popular was the Friday afternoon/evening Historical Exhibit and Anniversary Reception in the Grier Room, with 88 registered.

Eighty-one signed up for the Saturday mornings symposium and the Saturday evening reception and dinner numbered about 60. The oldest attendee was from the class of '32. I had many, many interesting conversations remembering "old times in VI-A," prompted by the historical documents displayed at the reception venue.

And so to the present. Recent honors and awards have gone to the following: **Denise D. Denton**, '82, SM '82, EE '83, PhD '87, has been promoted (with tenure) to associate professor at the University of Wisconsin. . . . **Harold Y. Hwang** and **Karl Sun** have been named Henry Ford II Scholars, given to seniors in MIT's School of Engineering "who have attained the highest academic record at the end of their third year and who have exceptional potential for leadership in the profession of engineering and in society." . . . **Richard S. Withers**, '76, SM '76, ScD '78, has assumed a new position at Conductus, Inc., in Sunnyvale, Calif., as head of Analog System Development involving superconducting films for microwave technology.

VI-A office visitors (alphabetically, since last writing) have included: **Dean R. Collins**, '59, SM '59, of Texas Instruments in Dallas, who was attending a meeting at MIT of the IEEE's Electron Devices Society; **Robert M. Gray**, '66, SM '66, on the Electrical Engineering faculty of Stanford University; **Steven K. Ladd**, '81, SM '81, who took Bob Weatherall, director of the Office of Career Services and Preprofessional Planning, and me out to lunch to discuss his new entrepreneurial activities; **Oscar P. Manley**, '57, SM '57, PhD '68, of the U.S. Department of Energy in Washington, D.C., whom I've known since my earliest days at MIT in 1956 when I was assistant to the department head; **Fred L. Terry, Jr.**, '81, SM '81, PhD '85, associate professor at the University of Michigan at Ann Arbor; and **Kenneth A. Zeger**, '84, SM '84, passing through from Hawaii on his way to his new position at the University of Illinois at Urbana.

I'd also like report an especially nice visit I had with **Lester A. Gimpelson**, '59, SM '59, EE '61, and

Marshall G. Schachtman, '58, SM '58, both of whom came to the VI-A 75th reunion reception, as they were among my first student acquaintances upon joining MIT in 1956. Lester has his home in Belgium, where he was with ITT Europe, Inc., up until his recent retirement. Marshall was with the Bell System until his recent retirement to Colorado.

Finally, I wish to correct a publishing error of this column in the August/September 1992 issue. In the fourth paragraph, discussing the Department's proposed new 5-year curriculum, the last sentence referred to a mechanical engineering plan. It should have read "...on which the whole master of engineering plan was based..."—**John A. Tucker**, Director Emeritus, VI-A Internship Program, MIT, Room, 38-473, Cambridge, MA 02139, 617-253-4645.

VII BIOLOGY



D.G. Schatz

training. The award is established in honor of Cheryl Whitlock, a postdoctoral fellow at Stanford University, whose work with Dr. Owen Witte in the field of hematopoiesis, the development of various blood cells, led to the establishment of the Whitlock-Witte culture procedure. The procedure allows the isolation of mouse cells which are able to produce growth factors such as SIF and IL-7. Schatz, also an assistant investigator at the Howard Hughes Medical Institute, concentrates his research on the process that combines segments of DNA to create the genes that form antibody structures and T cell receptors. Specifically, he focuses on which enzymes shuffle and combine the different segments of DNA to make antibody and T cell receptor genes. Before joining Yale, Schatz was a postdoctoral associate with **David Baltimore**, '61, at the Whitehead Institute for Biomedical Research, where Schatz's research led to the discovery of two recombinant activating genes critical to the DNA shuffling process, and essential for the development of the immune system. At Yale, Schatz tries to determine what roles these genes play in the DNA shuffling reaction, and to identify and isolate other factors that participate in the reaction. His goal is to understand the mechanism of the reaction and how it is regulated.

Phillips W. Robbins, the American Cancer Society Professor of Biochemistry at MIT, has been elected to the Institute of Medicine. Robbins, who is noted for his cancer research, is a member of the Center for Cancer Research. . . . **Gerald R. Fink**, director of the Whitehead Institute and Course VII professor, was honored at Yale University's commencement ceremonies held last May with the Wilbur Lucius Cross Medal for outstanding achievement in professional life. Fink, who received his PhD in biology at Yale in 1965, received the award "in recognition of outstanding contributions to research and teaching in genetics," according to his citation.

John L. Fuller, PhD '35, of Cambridge, Mass., died on June 8, 1992. Fuller was a retired professor of psychology at the State University of New York at Binghamton. He was a founder of the field of behavior genetics. Before his appointment

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to SUNY-Binghamton, he was a staff scientist and later associate director of the Roscoe B. Jackson Memorial Laboratory in Bar Harbor, Maine. He was a former Guggenheim Fellow and participant in an NSF program in India. He was a fellow of the American Psychological Association and former president of the Society for the Study of Social Biology. In 1987, he received the prestigious Dobzhansky Memorial Award for Eminent Research in Behavior Genetics. In addition to contributing numerous articles to professional journals, he was the author or co-author of four books.

VIII PHYSICS

The first Alan H. Barrett Prize for excellence in astrophysics has been presented to **Samuel R. Conner**, '82, SM '84 (XII), a graduate student in physics. The award was established in memory of Professor Barrett, who died last year. He was a member of the team that first detected and measured the presence of hydroxyl, or OH, radicals in interstellar space. The award recognizes exceptional research in astrophysics. Conner first became interested in the field as a UROP student working in a research group with **James Elliot**, '65, SM '65, Course VIII and XVI professor, where he completed SB and SM degrees. He returned to MIT in 1986 as a PhD candidate in the radio astronomy group spearheaded by **Bernard Burke**, '50, PhD '53, Course VIII professor. He participated in the MIT-Green Bank radio surveys and organized a large mapping program for these sources at the VLA, work that will form the basis of his dissertation. ... **Donald York**, '66, has been named the Horace B. Horton Professor in Astronomy & Astrophysics at The University of Chicago. York is director of the Apache Point Observatory, where the University and other members of the Astrophysical Research Consortium are constructing two advanced telescopes. He is an expert on the clouds of dust and gas that exist between stars and between galaxies. He worked as an astronomer at Princeton before joining the Chicago faculty in 1982. ... **Raymond H. Levy**, SM '50, has retired as chair of Reg Nat Usines Renault in France.

Victor F. Weisskopf, Institute Professor Emeritus, has added a new award to his list of honors—the Karl Taylor Compton Medal for Distinguished Statesmanship in Science. The citation for the award, given by the American Institute of Physics, reads: "To Victor F. Weisskopf, brilliant physicist and great statesman in science. He has led scientists throughout the world in advancing science, in promoting peace, and in seeking solutions to world problems. As director general of CERN (European Center for Nuclear Research), he led one of the world's most successful international cooperations and as founding leader of HEPAP (High Energy Physics Advisory Panel of the former Atomic Energy Commission) he successfully reconciled the conflicting demands of particle physicists. As a teacher and author he encourages and strengthens the finest traditions and deepest values of science." ... **Norman Radmussen**, PhD '56, the McAfee Professor of Engineering in Course XXII, has been selected as one of the first recipients of the Joel Spira Awards for Teaching Excellence. The \$1,000 awards were established a year ago by Joel and Ruth Spira, whose daughter and son-in-law received their doctorates in nuclear engineering at MIT.

IX BRAIN AND COGNITIVE SCIENCES

Mary Brown Parlee, PhD '69, has been named the Tallman Visiting Professor in Women's Studies at Bowdoin College for the 1992-93 academic year. Parlee is a professor of psychology in the developmental psychology subprogram of the gradu-

ate school and university center of the City University of New York, and is a former director of the university's Center for the Study of Women and Society. She has also taught at Barnard College, Columbia University, and Wellesley College. Parless has been a research fellow in psychology at Harvard Medical School, a research associate at the Social Problems Research Institute of the University of South Carolina, and a visiting research scholar at the Radcliffe (now Bunting) Institute at Radcliffe College. She is a former associate editor of *Psychology Today*. ... **John J. Earshen**, '51, has been elected a fellow of the Acoustical Society of America in recognition of his contribution to the advancement of acoustical instrumentation and standards pertaining to noise dosimetry. He is a consultant at Angevine Acoustical Consultants, Inc., of East Aurora, N.Y., and holds adjunct faculty appointments at the University of Toronto, the University of Buffalo, and Georgia Institute of Technology.

X CHEMICAL ENGINEERING

Robert W. Koch, SM '50, writes: "On January 31, 1992, I retired from the Morgantown Energy Technology Center of the U. S. Department of Energy in Morgantown, W. Va." ... From Washington, D.C., **Arnold F. Stancell**, ScD '62, reports: "I am VP for exploration and producing at Mobil Oil. My job has expanded responsibilities covering Europe, Australia, and the Middle East." ... **Joe Polack**, SM '43, ScD '48, sends word from Baton Rouge, La.: "I retired from Exxon in 1970 as director of Esso Research Labs. I retired from Louisiana State University in 1987 as director of LSU's Audubon Sugar Institute. I'm currently operating a small consulting business for chief executives." ... **John P. O'Connell**, '61, SM '62, chair of the Department of Chemical Engineering at the University of Virginia, has been named to the Harry Douglas Forsyth Professorship in Engineering at UVA. O'Connell's research expertise is in the thermodynamics and molecular theories of fluids and fluid mixtures.



Albert Sacco, Jr., PhD '77, professor and head of the Chemical Engineering Department at Worcester Polytechnic Institute, served as the voice of NASA's science mission control during the Space Shuttle mission last June. The flight, STS-50, carried the first U.S. Microgravity Laboratory, and was the maiden flight in a series of Spacelab missions devoted to U.S.

A. Sacco, Jr.

research in low gravity. Sacco, a NASA payload specialist, was a backup member of the science astronaut crew for the 13-day Spacelab research mission—the longest Shuttle mission to date. During the *Columbia* flight, he served as a spacecraft communicator, speaking directly with the crew and coordinating research activities from the Spacelab Mission Operations Control Center at NASA's Marshall Space Flight Center in Huntsville, Ala. Sacco was chief scientist for one of the experiments on the mission—the Zeolite Growth experiment, provided by WPI. During the mission, Sacco worked with scientists from across the country as they directed USML-1 research activities from the Huntsville control center. The U.S. Microgravity Lab mission series is designed to help the United States maintain world leadership in microgravity R&D. USML-1 will study basic scientific questions to gain new knowledge in materials science, biotechnology, combustion science, the physics of fluids, and the way energy and mass are transported within them.

Mayors Confer on City Design

Ask any mayor of a small to mid-size city what would most improve that city's downtown and you are likely to get the same answer: more people. Over the last few decades, the downtown activity, looks, and character of cities have suffered as people moved to the suburbs and took their business to suburban malls. Now mayors are looking for ways to draw residents and tourists back.

To that end, mayors of eight mid-sized cities—populations under 100,000—will come to Cambridge next April for the third annual Northeast Mayors' Institute on City Design, organized by the MIT Department of Urban Studies and Planning and co-sponsored by the National Endowment for the Arts. The three-day conference is one of four regional offshoots of the National Mayors Institute, formed in 1986 to address the concerns of mayors of large cities.

Associate Professor of Urban Planning J. Mark Davidson Schuster, PhD '79, is the director of the Northeast Mayors Institute, and he enlists faculty and graduate students from architecture and planning, as well as outside practitioners, as "faculty" for the institute. The institute fills a need for small cities, where there may be little or no professional planning staff, Schuster says, and where decisions are in the hands of volunteer planning boards with no access to the useful ideas developed in universities. He says that the protected conference environment offers mayors a place to discuss issues on which they have not yet formed a position, a situation that is hard to come by in the pressure cooker of local politics back home.

Conversations with participants in the previous rounds of the Northeast conference reveal common themes. "Things we once thought were small and insignificant—historical street lights, sidewalks with brick accents—really are significant to the consumer out there," says Mayor James Sheets of Quincy, Mass. These small amenities help to offset the efficiency in travel that is one of the enemies of the modern city, says Schuster.

Destructive traffic patterns can also be countered head-on. After attending the 1992 seminar, Sheets dropped a plan to build a sweeping exit ramp from Route 93 into downtown Quincy. The intent of the ramp was to draw traffic into the city

center, but architects pointed out that it would work just as efficiently to speed people out of town. Robert Campbell, a Cambridge architect and architecture critic for the *Boston Globe*, vetoed the proposed ramp and its attendant displacement of buildings as "a suburban idea in an urban setting."

The 1992 conference experts supported the mayors as protectors of their downtown areas, rather than letting developers dictate the cityscape. "Turning streets into malls is what we don't want to do. It should fit together as a downtown," says H. Alan Brangman, assistant director of the NEA Design Arts Program.

Developer Paula Collins, MCP '75, a principal at Western Development Group, Inc., in Redwood City, Calif., says that

"cookie cutter" corporate designs are common, but developers will be forced to do better if mayors insist on better designs and even hire their own architects. "A lot of resistance from developers isn't based on design philosophy," she says, "but on concern about delays."

After listening to colleagues and experts at last spring's gathering sharply criticize a hotel proposed for Oneonta, N.Y., Mayor David Brenner did exactly what Collins suggested. Brenner told the developer that the hotel design had no connection to the city, it looked like it could have been plunked down at an interchange on any interstate in the country. Schuster reports that the developer came back with a complete redesign.

If the conference had been held several years earlier, Oneonta might have been spared an eyesore. At one end of the city's Main Street, opposite City Hall, stands a brown, windowless building whose bunker-like exterior is relieved only by garage doors and entries painted bright red and blue. It looks for all the world like a warehouse, but in fact is a fire and police station. Someone in the community put up the first \$350,000 for the building in exchange for participating in the design, Brenner said, and the windowless bunker is the result. "It's functional," he noted dryly.

Mayor Gene Eriquez of Danbury, Conn., was able to implement tips he garnered during the 1991 conference. The city had four projects on the boards for a parcel of just under eight acres, including a medical center, condominiums and other housing, retail space, and movie theaters, with work to begin this summer. Eriquez says he successfully followed advice to push for more housing and more pedestrian walkways than were called for in the original proposals. The institute also emphasizes that development is a two-way street, so as its part of the bargain, Danbury improved traffic control, added street lights, more than tripled tree plantings, and repaired sidewalks.

Having seen how much impact the institute has had on the thinking and planning of past participants, Schuster has high hopes for this year. In fact, he'll take time out from a sabbatical in Barcelona to chair round three.

—KIMBERLY PATCH



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XI URBAN STUDIES AND PLANNING

Valerie Edwards, MCP '90, writes: "In its first year, my new social planning consulting firm, Edwards, Linkins & Associates, is evaluating family and children's services at a Connecticut elementary school and is analyzing enrollment data for a major health maintenance organization. I also serve as budget analyst for the financial advisory committee of the town of Brookline, Mass." ... **Toby R. Kramer**, SM '91, reports: "I joined the Boston Financial Group as a senior asset manager on June 1." ... Associate Professor of Economics and Urban Studies **William C. Wheaton** has been appointed director of MIT's Center for Real Estate Development. Wheaton has been active in the Center since its founding in 1984, both in teaching a core subject in real estate economics and in carrying out significant research on real estate markets. Wheaton, who helped to develop the field of urban economics by pioneering the theory of differentiated markets (such as those for land, location, and housing), believes that this difficult period in the real estate business cycle is a good time for MIT's Center to lead the way in emphasizing the importance of basic principles of economics. Lawrence Bacow, '72 (XIV), the Center's most recent director, has resumed full-time teaching in Course XI.

XII EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

In Mississauga, Ontario, **Pierre-Yves F. Robin**, PhD '74, sends word from the University of Toronto's Erindale Campus: "I was made a full professor three years ago and was named associate chair of the Geology Department last July 1." ...



K.L. Larnar

Ken L. Larnar, PhD '70, the Charles Henry Green Professor of Exploration Geophysics at the Colorado School of Mines in Golden, Colo., received the President's Award for Colorado School of Mines Outstanding Educator at the school's May 1992 commencement. The award is presented on a periodic basis to a full-time faculty member who has demonstrated excellence in teaching, research, and service over the past academic year. Four years ago, Larnar joined the CSM faculty after 18 years in industry with Western Geophysical Company.

John W. Clarke, '42, of Missouri City, Tex, died on April 10, 1992. He was a member of Phi Beta Kappa and Delta Tau Delta. During WWII Clarke served five years in the Army Air Corps. He retired as president of The Hartford Life Insurance Co. in Hartford Conn., and was director of the Hartford Fire Insurance Co. and major subsidiaries. He was a Fellow in the Society of Actuaries and a member of the Connecticut Bar.

XIII OCEAN ENGINEERING

Lieutenant Commander **Geoffrey L. Abbott**, SM '82, OCE '82, sends word from Petersburg, N.J.: "I started in July 1991 as the facilities engineer for the Coast Guard's Cape May Training Center, it's seventh largest base. We maintain over 300 acres, have some challenging environmental problems, deal with beach restoration, and continue to try to do more with less funding. Despite my ocean engineering background, I'm learning more and more about civil engineering. I enjoy the job immensely

and I'm enjoying playing tourist from time to time with my family. Cape May is a beautiful seaside area with lots to offer." ... Lieutenant Commander **Joseph Fallone**, SM '89, NE '89, has assumed new duties this past summer as project manager at Naval Sea Systems Command in Washington. For the two years prior, he was project officer for the Navy's Naval Shipyard R&D program in Portsmouth, N.H., where he spearheaded work on the USS *Memphis*, a Los Angeles-class submarine. ... Navy Captain **William G. Sutton**, SM '71, recently assumed command of Destroyer Squadron-24 Naval Station in Mayport, Fla. Sutton began his Navy career in 1966. ... Coast Guard Lieutenant **John F. Kaplan**, SM '86 (II & XIII), recently was deployed aboard the Coast Guard Cutter *Mellon*, (home port Seattle) for a routine patrol near the Alaskan Islands. Before leaving for the patrol, *Mellon* participated in the Columbia River Bicentennial Celebration in Astoria, Ore., and the "Say No to Drugs" campaign in Portland, Ore. While on the Alaskan patrol, Kaplan will help enforce the fisheries law in the Exclusive Economic Zone around the islands.

XIV ECONOMICS

Howard Rosenthal, '60, PhD '64, has been named a full professor of politics at Princeton University. Rosenthal is an expert on formal and quantitative political analysis. His current research interests include voting and coalition theory, public finance, macro political economy, American and European politics, and statistical methods. His appointment is effective July 1, 1993. He has served as a visiting faculty member at the Hebrew University in Jerusalem, the Fondation Nationale des Sciences Politiques in Paris, and at Williams College, the University of California at San Diego, and MIT. He currently holds a two-year appointment as a Fellow of the International Center for Economic Research in Turin, Italy. ... **Pedro Aspe Armella**, PhD '78, finance secretary of Mexico, has been elected to a five-year term membership of the MIT Corporation. From 1977-78 he was a research assistant and then an instructor at MIT in Course XIV. Returning to Mexico in 1978, he became professor and director of the Department of Economics at the Instituto Tecnológico Autónomo de México, serving in that post until 1982. From then until 1985 he was president of the National Institute for Statistics, Geography, and Information. In August, 1985, he became undersecretary of Programming and Budgeting, and two years later was named secretary. In December, 1988, he was appointed Finance Secretary of Mexico. His honors include distinguished achievement medals from the Hellenic Republic and the Government of Spain.

XV MANAGEMENT

Armand Feigenbaum, SM '48 (XV), PhD '51, president and CEO of General Systems, Inc., in Pittsfield, Mass., was given an honorary ScD by Union College in Schenectady, N.Y. Feigenbaum, who earned an undergraduate degree at Union, is one of the world's acknowledged experts on quality control. He worked as manager of manufacturing and quality control for GE until 1968, when he founded General Systems, a quality control consultant whose clients include IBM, Fiat, John Deere, and Bechtel. He is co-author of *Total Quality Control*, now in its 40th anniversary printing. ... **David Handmaker**, SM '86, writes: "We're thoroughly enjoying our 3rd year living in Hong Kong. Maina (3) and Orli (1 1/2) make us glad to be parents. I travel a lot to A.S.E.A.N. countries and Indian subcontinent, setting up new equity trading businesses. My wife, Karen, runs her own health care consulting business. Sure would like to see some visitors from Sloan." ... **Bill Hilliard**, SM '84,

reports from Dedham, Mass.: "I joined MicroTouch Systems a year ago to start a division selling chipsets that build special features into notebook PCs and pen-based computers. Hello to classmates I haven't talked to for a while. Ran into John Ison in Europe at a trade show last March and enjoyed catching up on things."

From Belgium, **Scott Beardsley**, SM '89, sends word: "My wife Claire and I had our first child on February 19—a beautiful baby boy named Edouard James Hartness Beardsley. We would love to hear from anyone coming by our way in Brussels." ...

Lee R. Morris, SM '54, reports from Rydal, Pa.: "I'm enjoying retirement with some modest amount of consulting." ... **Leon Fattal**, SM '65, writes: "CedarData, the company I helped to start in 1983, has had a terrific year. Our financial software, developed using the latest 4GL tools, has had considerable success with large and small companies in the U.K. In addition, our overseas initiatives have yielded results in Europe and Australia. Family is also good. We have three boys aged 12, 10, and 5." ... From Malden, Mass., **Ronni L. Kantner**, SM '89, writes: "I am engaged to be married to Paul Skerker. We are planning to be married in November 1992." ... **Julie Schwartz**, SM '90, and José Valle are the proud parents of twin boys. Gregory Lewis and Michael Joseph were born on June 19. The family resides in Wayland, Mass. ... **Torben Grønning**, SM '74, reports: "I am leaving London to return to my native Denmark. After 5 years as managing director of U.K.-based Sensitire Limited, part of Danish medical and scientific instrumentation group Radiometer, I am the new managing director of Elektronik Centralen, servicing users of electronics with R&D, design, consultancy, and certification."

Wilbur G. Lewellen, SM '61, PhD '67, the Loeb Professor of Management at Purdue University, has been named to the board of directors at the USF&G Corp. in Baltimore, Md. ... **Judy C. Lewent**, SM '72, VP for finance and CFO of Merck & Co., Inc., was named 1992 Woman of the Year by the Financial Women's Association of New York.



J.C. Lewent

Lewent is the first female CFO at a major company such as Merck, the world's largest pharmaceutical company. Lewent joined Merck in 1980 as director of Acquisitions and Capital Analysis. In 1983, she was promoted to assistant controller of the Merck Sharp and Dohme Research Laboratories and to executive director of financial evaluation and analysis in 1985. She was promoted to VP and treasurer in 1987 and was elected VP for finance and CFO in 1990. In accepting her award, Lewent said that young women should find something they really like to do, do it with energy to the best of their ability, and not worry about the next step. She told the FWA that during her career, she has concentrated on advanced finance and computer technology to help finance play a larger role in business. She noted that, just as finance needs to play a greater part in day-to-day business operations, business must be more active in community issues because "any company that wants to attract and keep the best people must factor the changing realities of its employees into its strategic planning."

Sloan Fellows

James G. Kaiser, SM '73, has been named president and CEO at Enesco Environmental Lab Services' Rocky Mountain Analytic Lab in Arvada, Colo. Previously, he was senior VP and general manager of the Technical Products Division at Corning Glass Works in Corning, N.Y. ... **James C. Foster**, SM '85, has been named CEO at Charles River Laboratories in Wilmington, Mass., and **E. Joseph**

Zemke, SM '77, has been named CEO at Amdahl Corp. in Sunnyvale, Calif. Previously, both men held the positions of president and COO at their firms. ... In September, ConAgra, Inc., named **Philip B. Fletcher**, SM '70, president and CEO of the Omaha, Neb., firm. He was previously president and COO. ... **C.C. "Pete" Peterson**, SM '72, gave a talk sponsored by the Newtown, Conn., Chamber of Commerce. ... **Richard A. Burke**, SM '79, president of Trek Bicycle Corp., has been selected as one of seven Wisconsin Entrepreneurs of the Year and named a world-class manufacturing entrepreneur. The program was initiated in 1986 by the Wisconsin office of Ernst & Young, and is co-sponsored by Merrill Lynch Pierce Fenner & Smith, Inc., and *Inc.* magazine. According to the program's judges, Burke "has made the bicycle as desirable and coveted a means of transportation as a Harley-Davidson motorcycle or a Lexus automobile." Burke co-founded Trek in 1975, but the business didn't take off until six years ago. The firm now employs 700 and boasts of 2,000 dealers operating abroad. Burke was recently quoted in the *Milwaukee Sentinel*: "I'm careful not to set quantitative goals. You don't need to predict profit, if you do everything right it will profit."



E.W. Kissel

ger/light truck area. Kissel has been with the company since August 1990, serving as executive VP for manufacturing. ... **Robert B. Horton**, SM '71, chair and CEO of British Petroleum of London in England, has been re-elected to a second five-year term membership on the MIT Corporation. The British native joined BP in 1957 and in the next two decades held a series of positions in oil supply, marketing, finance, and planning. In 1980 he was appointed CEO of BP Chemicals International and was elected to the BP board of directors as managing director in 1983. He became chair and CEO of the Standard Oil Co. in 1986, and, in 1988, was named managing director, BP and chair, BP America. He has been chair and CEO of BP since 1990. He also is chancellor at the University of Kent at Canterbury.

Senior Executives

John P. Desbarres, '84, adds a third title to his business card. He is now chair and continues as president and CEO at Transco Energy Co. in Houston, Tex. ... **Richard Dulude**, '69, vice-chair at Corning Glass Works in Corning, N.Y., has been named to the board of directors of Ambac, Inc., in New York City.

The Association of Alumni and Alumnae has been notified that **Amarjit Singh**, '61, of New Delhi, India, died on July 11, 1991. He was a retired director of Associated Cement Companies.

Management of Technology Program

Frederick D. George, SM '87, is now president of the Flatirons Group in Boulder, Colo. ... **Tsuneo Kobayashi**, SM '87, is now manager of the Planning Department Technological Division at Shimizu Corp. in Tokyo. ... **George Sonoda**, SM '87, is now Time-To-Market Improvement Program manager at Sematech in Austin, Tex. He is currently responsible for developing a program to improve semiconductor equipment supplier cycle times. ... **James G. Timmins**, SM '87, is director of

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product development at Agracetus, Inc., in Wisc. The company is a world leader in gene delivery technology for agriculture and medicine. . . . Commander **Tommy Gardner**, SM '88, met with this year's MOT class on June 30 to discuss *Gunfire at Sea: A Case Study of Innovation*. . . . **Joseph Gilman**, SM '90, is director of International Operations at Bell South Enterprises, Inc., in Atlanta. He and his wife Susan met with this year's MOT class for an informal talk and reception on July 2. . . . **R. Tom Lydon, Jr.**, '73 (IV), SM '90, is acting department manager at Raytheon MSD. . . . **Youchi Ohshima**, SM '90, is now manager of the Real Estate Planning Department at Nippon Life Insurance Co. in Japan. His "task is to strategize the portfolio of the asset management and to plan new schemes of investments." He now lives near the Tokyo Disneyland and the family can enjoy fireworks every night. . . . **Craig Wall**, SM '90, was vacationing in Boston with his family last July. They were revisiting favorite haunts and visiting friends made during their one-year stay in Wellesley. . . . **B. Joe Pine**, SM '91, and his wife, Julie, recently bought a house in Richfield, Conn. Joe reports that he will be with the Management Research Function at IBM in New York for the next 3-5 years.

Luis Rendon, SM '91, is the technological strategy director at Vitro in Monterrey, Mexico. He wrote: "I am applying what I learned, and it will make my company successful and competitive." . . . **Bruce Dewar**, SM '92, **Armando Izquierdo**, SM '83 (II), SM '92, and **Yoichi Sakamoto**, SM '91, were participants last May at a workshop entitled "The Internationalization of R&D" sponsored by the MIT Industrial Liaison Program. **Mark Taylor**, SM '91, also attended the workshop. . . . **Carlos Diez**, SM '92, is general manager of Metalmeccanica and Metalcentro, two companies of the TECHINT group of companies in Buenos Aires. . . . **Koichi Hagishima**, SM '92, is manager of engineering strategy in the Technology Research Department of NTT in Japan. . . . **Solomon Israel**, SM '92, has been promoted to joint venture program manager, F22AX at General Electric & Sanders. . . . **Armando Izquierdo**, SM '83 (II), SM '92, is manager of corporate planning at Intevep in Caracas, Venezuela. . . . **Dave Mattis**, SM '92, has been promoted to staff engineer/Engineering Processes & Math-based Technology at Cadillac Car Division in Detroit. Dave reports that he has found Professors Roberts' and Shiba's classes especially useful, notably Roberts' linkage of marketing and engineering. Dave and Lorraine miss the MOT class of '92 family. . . . **Eyal Meltzer**, SM '92, and his wife, Ofra, have a new son named Leor. He was born on July 6, weighing in at 7 lbs., 13 oz., and measuring 21 inches in length.—Fay Wallstrom, Management of Technology Program, MIT, Room E56-304, Cambridge, MA 02139.

XVI AERONAUTICS AND ASTRONAUTICS

From Boston, **Robert F. Weiss**, SM '59, writes: "As this is written, Physical Sciences, Inc., is 'going public.' Hopefully effective as of July 1, PSI will have been traded on the American Stock Exchange (symbol: PHS)." . . . **Dava J. Newman**, SM '89 (TPP), PhD '92, has been elected to a five-year membership on the MIT Corporation. Newman is the new board member from recent classes. Her many accomplishments at MIT encompassed both scholarly and athletic activities. In the former category, she served as a UROP supervisor for six years, was a research assistant in Course XVI's Space Shuttle Flight Experiment, studied under a NASA Graduate Student Researcher's Fellowship, and was an executive board member of the founding conference of the International Space University. In 1991 she set the women's world speed record for human-powered hydrofoil boats. She was a member of the MIT women's cycling team, participating in the national championships, and was an assistant coach of both the varsity

women's basketball team and the varsity alpine ski team. She plans to begin a teaching career as a university faculty member this fall. . . . **Laurence R. Young**, '57, SM '59 (VI), ScD '62, Course XVI professor, has been elected to the Institute of Medicine. Young has studied the causes and prevention of space motion sickness. He is currently training as a payload specialist with NASA for a possible space flight in 1993 on Spacelab. . . . **Sheila E. Widnall**, '60, SM '61, ScD '64, associate provost and Abby Rockefeller Mauzé Professor of Aero & Astro, has been elected to a three-year term on the National Academy of Engineering's governing council.

XVII POLITICAL SCIENCE

From Houston, Tex., **Dana G. Mead**, PhD '67, sends word: "In May 1992 I was named president and COO of Tenneco, Inc., a diversified industrial company ranking 26th on the *Fortune* 500." . . .



E.J. Feldman

Elliot J. Feldman, PhD '73, has been named a partner at the Washington, D.C.-based law firm of Howrey & Simon, where he will practice international law. Formerly, Feldman worked for Ackerson & Feldman, where he was lead counsel for the Gouvernement du Quebec in the countervailing duty and antidumping cases covering pure and alloy magnesium, softwood lumber, fresh, chilled, and frozen pork, beer, and live swine. He also represented Quebec in other trade and political matters. In his new position, he is expected to continue this full general representation. Before starting his own firm, Feldman practiced at Steptoe & Johnson. While there he served as the coordinator for the representation of the Embassy of Canada in addition to representing and advising Quebec in all trade matters arising before the U.S. Department of Commerce and in proceedings before the U.S. Trade Representative. In addition to his international trade practice, Feldman has served as a special project officer and consultant to the Assistant Secretary of Defense. He has been a foreign associate of the Royal Institute of International Affairs in the United Kingdom, and he is councillor at the Atlantic Council of the United States. A former professor of public policy and decision-making, specializing in Canadian and European Affairs, Feldman founded and directed the University Consortium for Research on North America at Harvard University from 1979-85.

Harvey M. Sapolsky, **Rhonda J. Crane**, PhD '77, **W. Russell Neuman**, and **Eli M. Noam** are the editors of *The Telecommunications Revolution: Past, Present, and Future* (Routledge, 1992). "The book presents a unique perspective on the dramatic changes sweeping telecommunications worldwide. It charts a global restructuring of telecommunications industries, away from the monopoly structures of the past towards increased competition, deregulation, and privatization," states the book jacket. Sapolsky is professor of public policy and organizations at MIT and director of the Communications Policy Research Program, Communications Forum, and the Defense and Arms Control Studies Program. Crane is director of Federal Government Affairs at AT&T. She was recently on loan as senior adviser for Science, Technology, and Investment Affairs to the Office of the U.S. Trade Representative, Executive Office of the President, the White House. Newman is director of the Communications Research Group at MIT's Media Lab.

XVIII MATHEMATICS

Eugene Gath, PhD '89, writes: "I have been lecturing in mathematics at the University of Limerick since 1990. We are a new technological university in Ireland, aspiring to be 'Ireland's MIT'! I teach mathematics to scientists and engineers as well as continue my own research. This year I won the Teaching Excellence Award (worth—\$1,700) at the University of Limerick. I hope to visit MIT to meet with the few friends there who still haven't graduated!" ... **Lance Fortnow**, PhD '89, assistant professor of computer science at the University of Chicago, has been named a National Science Foundation Presidential Faculty Fellow. One of the 30 young scientists and engineers recognized for excellence in research and teaching, Fortnow will receive \$500,000 to support his work over the next five years. Fortnow is an expert in computational complexity theory—the study of how much computer time and memory are needed to solve different types of computational problems. In his recent research, he has studied methods for verifying long, complex computer programs and has investigated the power of "interactive proofs," a technique that uses a trustworthy small computer to check the results of a much larger, not necessarily reliable computer. He hopes to build on recent work that has shown that the interactive proof technique places a limit on how well computers can estimate answers to some extremely difficult problems.

William W. Roberts, Jr., '64, PhD '69, professor of applied mathematics at the University of Virginia's School of Engineering and Applied Science in Charlottesville, Va., has been named Commonwealth Professor. As director of the university's Mathematical-Computational Modeling Laboratory, Roberts' professional work focuses in part on developing the mathematical equations that express events that are observed in nature and in the experimental laboratory. He has developed algorithms for computer models that allow researchers to study the motion, drag, and stability of fibers in steady and turbulent gas flows, the dynamics of hypersonic gas flows, and the structure and dynamics of galaxies. His other research areas include intelligent-control systems and simulations, intelligent control, manageability, feedback, computational fluid dynamics, shock waves and nonlinear phenomena, and prototype technologies for fiber processing operations. Roberts has been at the UVa since 1969.

XX APPLIED BIOLOGICAL SCIENCES



C.J. Bates

Charles J. Bates, PhD '57, VP of the technical group at American Maize Products Co., was elected to the board of directors of the American Association of Cereal Chemists (AACC). Bates has been with American Maize Products Co. for 19 years. He previously was in the Food Products Division and Industrial Detergents Division of Procter & Gamble Co. for 15

years. His work at Procter & Gamble included bakery mixes and bulk shortenings and some of his early work led to the Duncan Hines Angel Food Cake Mix. Other career responsibilities have included process and product development for both new and existing products, customer service, sales and marketing, and most recently, process development and plant design and construction for high fructose corn syrup. A member of AACC since 1972, Bates has served the cereal chemistry profession in many capacities including as member of the

AACC short course faculty of Introduction to Cereal Science and Technology, member of the AACC Cereal Foods World Editorial Advisory Board, president and treasurer of the Institute of Food Technologists, part of the VP program of the Calumet Council BSA and chair, vice chair, and member of the anniversary celebration committee of the AACC Carbohydrate Division.

The Association of Alumni and Alumnae has been notified that **Kathleen S. Sargent**, PhD '71, of Winchester, Mass., died February 19, 1991, as a result of an automobile accident. No further information was provided.

XXII NUCLEAR ENGINEERING

Patrick M. Hogan, SM '89, writes: "I am currently a senior engineer with ABB Impell Corp. in Lincolnshire, Ill. Presently, I am the project engineer on a project that involves performing various engineering analyses to support an upcoming dual unit outage and the associated modification work for the Zion nuclear power plant in Zion, Ill." ... **Philip F. Palmedo**, SM '58 (X), PhD '61, has been named president and CEO of the newly formed Long Island Research Institute. LIRI was formed when three of Long Island's major research institutions joined forces to accelerate the flow of technology to industry and to contribute to Long Island's economic development. Concluding a year of discussions, the University of Stony Brook, Associated Universities (the managing corporation of Brookhaven National Laboratory), and Cold Spring Harbor Laboratory agreed to create the LIRI. The non-profit corporation will focus on bringing new technologies from the academic sphere to the world of commerce. Collectively, the three founding institutions employ more than 1,500 PhD or MD researchers and annually conduct more than \$400 million in sponsored research. In its technology transfer activities, the Institute will have an active program of technology evaluation and will facilitate the application of technologies through licensing agreements, joint ventures, and company start-ups. ... **Richard R. Sonstelie**, SM '68, has been named president and CEO of Puget Sound Power & Light Co. in Bellevue, Wash. Prior to this May 1992 promotion, Sonstelie was president and COO of the company.

Navy Commander **David W. Hearing**, SM '77, ENE '77, recently received the Legion of Merit. Hearing was cited for "outstanding performance as commanding officer aboard the submarine USS *Pargo*, homeported in New London, Conn." According to a Navy release, "As an extremely competent and resourceful leader, he performed his duties in an exemplary and highly professional manner. His superb leadership abilities were instrumental in the exceptional performance of the *Pargo*, and the remarkable improvement in its material condition and operations readiness. Under Hearing's expert guidance, the *Pargo* performed superbly and set standards of excellence during numerous and ever-changing at-sea operations." Hearing is currently assigned with Submarine Development Squadron 12, Naval Submarine Base, New London, Conn. He joined the Navy in 1968. ... **Jacquelyn C. Yanch**, the W.M. Keck Career Development Assistant Professor in Biomedical Engineering and assistant professor of nuclear engineering, has received a \$25,000 Junior Faculty Career Award from the School of Engineering under a program supported by the GE Foundation. The foundation's Faculty for the Future program is designed to increase the number of women and members of underrepresented minority groups on the engineering, science, and business faculties in the United States. The foundation has committed \$330,000 over three years to MIT. Yanch, a member of the Course XXII faculty and Whitaker College since 1989, is involved in three major projects: the design of neutron beams for boron-capture therapy for brain cancer victims; studies of dose distributions of isotopes injected in human joints; and development of data-visualization methods for tomography in medical diagnosis.

TPP TECHNOLOGY AND POLICY PROGRAM

MIT Professors **Joel Clark**, SM '75, (XV), ScD '72 (III), **David Marks**, and **Richard de Neufville**, '61, SM '61, PhD '65 (I), traveled to Norway together in May, along with **Frank Field**, '78 (XXII), SM '81 (XXII), SM '81 (TPP), PhD '85 (III), as part of an MIT team establishing relations with a consortium of Norwegian companies and the Norwegian Technical Hockschule. ... At the end of July, Professor de Neufville was the featured speaker at the Mexican Academy of Engineering, speaking on the development of TPP worldwide and at MIT. ... **James Durand**, SM '78, is now designing simulators for power plant operations at TRAX Corp. in Virginia. ... **Paul M. Hauge**, SM '83, has been accepted at Harvard Law School beginning September 1993. ... Having completed a PhD in economics at Sloan, **Mark J. McCabe**, SM '86, PhD '92 (XV), is now employed in the Antitrust Division of the U.S. Department of Justice. There are so many TPPers in Washington, D.C. Friends can contact him at 703-329-1718. ... After spending a year and a half in Argentina, and running his own company for a while, **Richard Tomlinson**, SM '87, has entered the British Foreign Office, working in the Environmental, Science, and Energy Department.

Michael Massimino, SM '88, SM '88 (III), ME '90 (II), PhD '92 (II), has accepted a position with McDonnell Douglas in Houston, Tex. He will be working on research and operations for the space station. ... **David Gold**, SM '90 (XVI), SM '90, is currently the Associate Director of the Manufacturing Technology Center Program at the National Institute of Standards and Technology. There are presently seven centers, each in different states, which help small and medium-sized manufacturers modernize and become more competitive. ... **Ziad Oueslati**, SM '90, is working for Citibank in Tunis. ... **Michael R. Berube**, '89 (I), SM '92 (XV), SM '92, has started a new job with Chrysler Corp. as an environmental planning specialist working on alternative fuels, fuel economy, global warming, and electric vehicle issues. ... **Lola Matysiak**, '91 (I), SM '92, has relocated to Los Alamos, N. Mex., where she is working at the Los Alamos National Laboratory. —Richard de Neufville, Technology and Policy Program, MIT, Room E40-252, Cambridge, MA 02139.

STS PROGRAM IN SCIENCE, TECHNOLOGY & SOCIETY

Professor **Merritt Roe Smith** became the director of the Program in Science, Technology, and Society on July 1, 1992. He succeeded **Kenneth Keniston**, who has completed a five-year term as director. Smith joined the MIT faculty shortly after the founding of STS in 1977. He played a major role in the development of the doctoral program in the History and Social Study of Science and Technology, which he has directed since 1987. Smith has been Metcalfe Professor of Engineering and Liberal Arts, co-director of MIT's Context Initiative, and immediate past president of the Society for the History of Technology. He is author or editor of three books and numerous articles and reviews. He also edits the Johns Hopkins Press series on the history of technology and serves on the boards of trustees of the Hagley Museum and Library, the Museum of American Textile History, and the Charles Babbage Institute as well as the history advisory committees of NASA and the Secretary of the Air Force. ... Professor **Evelyn Fox Keller**, known for her work on gender and science and on the history of biology, has joined the STS faculty as professor. Keller was most recently on the faculty of the University of California at Berkeley. Keller began her scholarly career as a natural scientist, with a PhD in physics from Harvard. She went on to work in mathematical biology, and became known for her collaborative studies of chemotaxis and aggregation. She then turned

toward a second field, studies of the relationship of gender and science. Her works in this field include her biography of Barbara McClintock, *A Feeling for the Organism* (written several years before McClintock won her Nobel Prize); articles on the relationship between gender, the conception of science, and the idea of objectivity; her volume, *Reflections on Gender and Science*; and continuing work on the relationship between gender-linked concepts and work in biology. In the last five years, Keller has increasingly turned toward studies of the history of the life sciences, in particular of molecular and evolutionary biology. Keller expects to teach at both the undergraduate and graduate level; her courses will focus on gender and science and on the recent history of evolutionary biology. Next year, she will oversee the weekly Monday-afternoon STS Colloquia.

Hugh Gusterson, an anthropologist who has studied nuclear weapons production, joined the faculties of the Anthropology/Archaeology Program and the STS Program as assistant professor. Gusterson received a bachelor's degree in modern history from Cambridge University in 1980. He subsequently studied cultural anthropology at the University of Pennsylvania, where he received a master's degree, and at Stanford, where he received a PhD in cultural anthropology in 1991. He is currently a Weatherhead Postdoctoral Fellow at the School of American Research in Santa Fe. Gusterson is best known for his ethnographic studies of nuclear weapons producers and their opponents at the Livermore Laboratory. He has also written on orientalism and the discourse of nuclear deterrence. In STS, his teaching will focus on the ethnographic and cultural study of science and technology. . . . **Victor McElheny** and **Eugene Skolnikoff**, '50, SM '50 (VI), PhD '65 (XVII), attended the second meeting of the Working Group on "Cultural Aspects of SETI" in Santa Cruz last May. . . . **Leon Trilling** headed a workshop for 60 middle-school teachers last July at MIT. The theme of the workshop was "How Does a City Work?"

The Mellon Fellowship Committee has selected three Fellows in the History and Social Studies of Modern Life Science for the academic year 1992-93. The Fellows will participate in STS seminars, colloquia, and workshops while pursuing their research at MIT. According to Charles Weiner, committee chair, their research interests are especially relevant to the theme of the 1993 Mellon Workshop on international aspects of genetic engineering and biotechnology, including cultural and political significance. The 1992-93 Mellon Fellows are **Richard Doyle**, **Michael A. Fortun**, and **Herbert Gottweis**. Doyle is an instructor in the Department of Rhetoric at the University of California at Berkeley. He is in the final stages of writing his doctoral dissertation, "On Beyond Living: Vital and Post Vital Rhetorics in Molecular Biology," and has taught "The Rhetoric of Technology" at Berkeley. His next project will deal with the use and impact of computers and computational metaphors in contemporary molecular biology. Fortun is completing his doctoral dissertation, "Mapping Genes, Science, and Society: Charting the Human Genome Project," in the Department of History and Science at Harvard. He has also served as a teaching fellow in the history of science. His next project will be an historical and sociological study of the context of the genome project in molecular biology and in the political economy of the biological sciences and the biotechnology industry. Gottweis is assistant professor in the Department of Political Science at the University of Salzburg. He is editor of the *Austrian Journal of Political Science*; his published works include studies of the politics of biotechnology in Europe. At Salzburg he has taught a course entitled "Biotechnology, Politics, and Society in Comparative Perspective." At MIT he will focus on completing his book, *Retextualizing Life: Genetic Engineering and the State in Western Europe* (MIT Press). Gottweis is a member of the Advisory Committee for the Mellon Workshops.—Graham Ramsay, STS Program, MIT, Room E51-128, Cambridge, MA 02139.

PUZZLE CORNER

Continued from Page MIT 47

ONE
ONE
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ONE

MANY

Solutions are: ONE = 362, MANY = 5068; ONE = 438, MANY = 6132.

TWO + ... + TWO = WAYS (29 TWOs).
Solutions are: TWO = 147, WAYS = 4263; TWO = 271, WAYS = 7859.

TRICKY
TRICKY

EUREKA

Solutions are: TRICKY = 152697, EUREKA = 305394; TRICKY = 436901, EUREKA = 873802.

Other Responders

Responses have also been received from S. Althuler, J. Grossman, D. Garcia, W. Hartford, R. High, D. Kahn, J. Keilin, J. Libby, E. Lund, A. Ornstein, G. Rice, J. Rosenthal, D. Wachsman, and R. Yassen.

Proposer's Solution to Speed Problem

Go to a 5-dollar crap table and bet 5 dollars on "Come" and 5 dollars on "Don't come" simultaneously.

GAZETTE

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617-253-4733

Deceased

The following deaths have been reported to the Alumni/ae Association since the *Review* last went to press:

James M. Ralston, '16; June 13, 1992; Trenton, N.J.
Harvey M. King, MAR '23; July 6, 1992; Ft. Walton Beach, Fla.
Howard A. Lockhart, '23; June 18, 1992; Haverhill, Mass.
Arthur R. Stuckey, '23; July 15, 1992; Tucson, Ariz.
Hyman J. Verner, '23; June 9, 1992; Pikesville, Md.
Neil L. Olken, '24; December 12, 1988; Newton Centre, Mass.
George A. Whinery, SM '25; July 9, 1992; Grand Rapids, Mich.
Avedis M. Kazazian, '27; January 27, 1988; La Canada, Calif.
Robert G. Loomis, '29, SM '30; August 30, 1991; Manchester, Conn.
Michael Anthony, '32; July 13, 1992; North Falmouth, Mass.
Robert H. Hansen, '32; May 19, 1992; Lakeside, Calif.
Norman M. Johnsen, '34; January, 7, 1992; Atlantic Beach, Fla.
Willard F. Bixby, '35, SM '36; July 12, 1992; Novelty, Ohio
J. Lawrence Tobey, '36; June 24, 1992; Wenham, Mass.
William A. Williams, SM '36; February 4, 1990
Herbert P. Gusdane, '37, SM '38; December 1, 1991; Mentor, Ohio
Charles J. Palmer, SM '37; July 26, 1992; East Sandwich, Mass.
William J. Pattison, '37; June 28, 1992; Camden, Maine
Norman E. Weeks, '38; July 8, 1992
Donald B. Peck, '39; July 1, 1992; Bloomfield, Conn.
William W. Pomeroy, SM '40; July 14, 1992; Alexandria, Va.
Michael B. Bever, SM '42, ScD '44; July 17, 1992; Cambridge, Mass.

Robert V. Coleman, '44; January 9, 1992; McLean, Va.
Frank J. Huddleston, '45; April 8, 1992; Bowie, Md.
Keith Knutzen, '47; October 14, 1991; Bronxville, N.Y.
Richard C.B. Berry, '48, SM '49; August 8, 1992; Danielson, Conn.
Earl D. Hoyt, '48; June 6, 1992; Menlo Park, Calif.
George G.C.K. Mah, PhD '48; May 28, 1990; Evanston, Ill.
Manfred G. Wentzel, '48; June 14, 1992; Indian Harbor Beach, Fla.
Nesbit L. Duncan, '49; June 15, 1992; Belmont, Mass.
Richard W. Henderson, '50; July 13, 1992; Colonia, N.J.
Bernard Edelman, '53; June 28, 1992; La Mesa, Calif.
Howard W. Wong, '53; August 30, 1990; Silver Spring, Md.
Arthur W. Haines, '54; August 6, 1992; Sacramento, Calif.
William N. Talmers, PhD '54; July 9, 1992; Flushing, N.Y.
John R. Segal, PhD '59; January 31, 1990; New York, N.Y.
Immo-Ragnar H. Nordstrom, '60; April 27, 1992; Fair Haven, N.J.
Robert Akullian, '70; July 20, 1992; San Jose, Calif.
Sandra A. Wadsworth, MAR '74; September 15, 1991; Brookline, Mass.
Steven K. McClung, '84; July 11, 1992; Atkinson, N.H.

Correction: April's Deceased List erroneously listed the date of death of Laurence Edmund Noble, '23, of Enid, Okla., as August 9, 1992. It was actually Mrs. Laurence Edmund Noble, '23, the former Gladys Farmer, who died on that date; her late husband was an alumnus of Harvard. Our apologies for the error.—Ed.

Parking Lotto

I had an interesting experience yesterday (23 August). My wife Alice had to talk at the National Psoriasis Foundation in Orlando during the weekend so the family used the cheap summer airfares for a chance to see Disneyworld. Our routing home was Orlando-Miami-NYC (don't ask). Hurricane Andrew arrived this morning in Miami. Well, yesterday at Orlando the final word from the airline was that if you went to Miami, you were "on your own" and "the Miami airport is all glass." There was a noticeable time warp that occurred at the airport entrance. While we were driving from Orlando, Andrew was reported as due to hit Miami in 14 hours. Once we were inside the airport, the only word we could hear is that it would be "soon," and tensions were getting pretty high. We decided to chance it, in part because there were no seats available leaving Orlando for anywhere. We were also encouraged by the words of a wise pilot, who noted that they would not fly a plane into Miami unless they were darn sure that the plane could get out. Extrapolating (dangerously?) I concluded that the airline would not allow its four o'clock flights to fly in unless it expected they would all get out. Bottom line: we left Miami at 5:45 in calm weather. But no flights were landing—the four o'clock batch was the last.

Readers may be interested in an impressive compendium of puzzles entitled *Index to Mathematical Problems 1980-1984*, edited by Stanley Rabinowitz and published by MathPro Press. Also, my NYU colleague Dennis Shasha has just written *Codes, Puzzles, and Conspiracy*, a second Dr. Ecco book. Finally, our frequent contributor, Nob Yoshigahara, has written a book including a few problems from "Puzzle Corner." Nob's book is in Japanese; the only word I can read is "Puzzle" set in big type on the cover.

Problems

N/D 1. We begin with a computer-related problem that Max Hailperin heard

from Albert Faessler. A primitive pythagorean triple (PPT) is a triple of positive integers (a, b, c) such that $a^2 + b^2 = c^2$ and a , b , and c have no common factor (this last condition is what makes the triple "primitive"). The area of a PPT is $ab/2$. Euler found that the smallest area shared by three PPTs is 13123110. What is the next smallest area shared by three PPTs?

N/D 2. Gordon Rice wants you to find (non-equilateral) triangles containing a 60-degree angle. How about a 30-degree angle?

N/D 3. Tom Harriman wonders for what values of X does the following "infinite exponential" converge.

$$X^{X^{X^{\dots}}}$$

Speed Department

Speedy Jim Landau sent us a speed problem from Eric Weill. To avoid the 5-dollar parking fee at Atlantic City casinos, it is necessary to place a bet. What bet should you make to get your free parking with the least risk?

Solutions

JUL 1. We begin with a bridge problem from Richard Hess, who (I guess) always seems to get low point count hands and likes to see how far they can go. Inspired by the 1991 Jan 1 problem, Hess asks for the lowest number of high card points that North and South can have (combined) and still make 7NT against best defense.

The following solution is from Edward Sheldon: South is assumed declarer, and West is on lead. North/South (NS) must have the ace of every suit in the West hand. Therefore West cannot have 13 cards of one suit. If West has 3 or 4 suits, NS must have 3 or 4 aces, for 12 or more points. Since at least one solution of less than 12 exists, there is no minimum solution where West holds more than 2 suits. For all minimum solutions, West holds exactly 2 suits. Further, all 13 NS tricks must come from the same 2 suits, to avoid a third NS ace. There are 26 cards in 2 suits; with 13 in the West hand, the other 13 must be played one per trick to win a grand slam; therefore they must all be in one hand.

Assuming West and South share the hearts and spades, with South arbitrarily long in spades, and that East holds all the point cards in clubs and diamonds, the following 11-point solution is obvious:

	West	South
♠	K	A, Q, J -> 2
♥	K -> 2	A

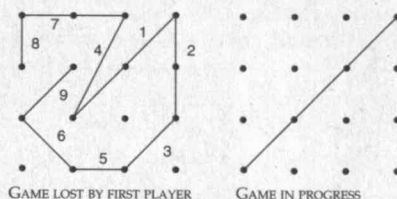
This solution is also a minimum. South's aces have already been proved necessary, and since the West spade K must be singleton, the spade Q and/or J cannot be moved to the West hand, and by the 2-

suit restriction, they cannot be moved to the East hand, thus they must stay in the South hand. Since all 4 honors are necessary, no lower solution exists and the above is a minimum solution.

JUL 2. Matthew Fountain suggests we tackle the "hold that line" problem devised by Sid Sackson and appearing in his book *A Gamut of Games*.

"Hold That Line" is a game in which two players alternate drawing straight lines between dots on a 4 x 4 dot field. The player to draw the last line loses. The first diagram shows a game in which the lines are numbered in the order they were drawn. Restrictions are that lines after the first shall only be drawn from the free end of a previously drawn line. All lines must be straight and start and end at a dot. A line may connect more than two dots if all are in a straight line. No line shall be drawn to a previously connected dot or cross another line.

The second diagram shows a game in progress where the first player has drawn his first line along a long diagonal of the field. Is this a winning or a losing move? There can be no ties.



Steve Althuler advocates a "copy your opponent" strategy. The second diagram shows an easy win for the first player. S/he has divided the board in half, and can now mirror whatever move the second player makes onto the other half of the board. Thus, the two halves will always remain identical, and whenever the second player is able to make a move, the first player will be able to make the same move on the other half.

This strategy means there are many other first moves which guarantee a win for the first player. Using spreadsheet-type notation on a 4x4 board, not only is A4-D1 a win, so are: A1-D4, A2-D3, A3-D2, B1-C4, and C1-B4.

This being the case, "Hold that line" now has all the strategic appeal of tic-tac-toe, unless you ban first moves that bisect the board.

JUL 3. Geoffrey Landis has found our previous cryptarithmic problems (where you are given an arithmetic equation such as $XXX + Y = YZZZ$ and must find which digits to assign to each letter, in this trivial case $X=9, Y=1, Z=0$) "rather uninteresting." So he offers a challenge. Find a cryptarithmic problem with (precisely) two solutions based on two (completely) different keys, i.e., no letter is assigned the same digit in both solutions. I would not be surprised to find that Nob Yoshigahara has a few dozen of these sitting under his socks in his bureau.

Bob High sent us some that even "make sense."

ONE
ONE
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ONE



SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO ALLAN J. GOTTLIEB, '67, THE COURANT INSTITUTE, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y. 10012, OR TO: GOTTLIEB@NYU.EDU

Continued on Page MIT 46

MIT LIFE INCOME FUNDS

DR. AND MRS. HARL P. ALDRICH, JR.

HOME: Concord, Massachusetts

CAREER: After receiving his S.B (1947) and Sc.D. (1951) degrees from MIT in civil engineering, Dr. Aldrich served six years on the MIT faculty, teaching courses in soil mechanics and foundation engineering. In 1957, he co-founded the consulting engineering firm Haley & Aldrich, Inc. Based in Cambridge, the firm specializes in geotechnical engineering and the environmental geosciences, with 300 employees and eight offices, located primarily in the Northeast. Dr. Aldrich is now chairman emeritus of the firm.

Throughout his career, Dr. Aldrich has been active at MIT. He was president of the Alumni Association in 1980-81 and served on the Corporation from 1980 through 1986; for three of those years, he was on the Executive Committee. He is vice chairman of the Boston Campaign Committee of the Campaign for the future.

Lois and Harl Aldrich met at the University of Iowa in 1944 while he was in the Navy V-5 Flight Training Program and she was finishing her master's in anthropology. They married in 1946 and were among the first residents of the original Westgate. They have five children and eight grandchildren.

GIFT OF CAPITAL: The Harl P. and Lois G. Aldrich Charitable Remainder Unitrust.

QUOTE: "For nearly 50 years, MIT has been a big part of my life. Each experience renews my admiration for the place, the excellence of its faculty and students and the enormous diversity in its educational programs and research. A gift of appreciated property was our way of making a significant contribution that strengthens this world-class institution, while providing us with tax advantages and income during our lives."

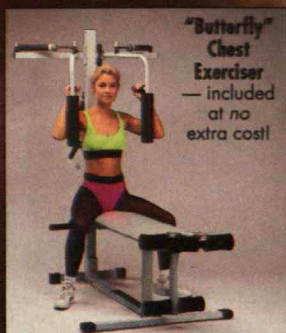
For more information about gifts of capital, write or call Hugh Darden, Frank McGrory or Kevin Larkin at MIT, 77 Massachusetts Avenue, Room 4-234, Cambridge, Massachusetts 02139-4307; (617) 253-3827.

Photo: Richard Howard

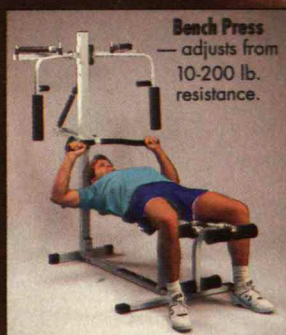


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ELECTION '92



Push Comes to Shove on Technology Policy

*George Bush and Clinton each promise to
apply technology, though in different directions,
to fix what ails the economy. But both are
missing a historic opportunity.*

PERHAPS for the first time in
a presidential election,
“technology policy” is a
major theme in both cam-
paigns. Voters are worried about the
sick economy, and technology is seen
as part of the cure. Technological
innovation helps spur productivity,
which in turn helps support invest-
ment, education, and high wages.

Alarm over the erosion of U.S. eco-

By GARY CHAPMAN

ILLUSTRATION: JON MCINTOSH

Unfortunately for Bush, the economy has gone sour when he must ask for a second term.



nomic strength was expressed in several recent blue-ribbon panel reports that unanimously called for more government action, especially with regard to technological development. A National Academy of Sciences panel suggested in April the creation of a Civilian Technology Corporation—a quasi-governmental, self-funding source of venture capital launched by a one-time federal grant of \$5 billion. And a panel convened by the National Science Board, the policy arm of the National Science Foundation, proposed in August a program of increased government investment in technological research. Roland W. Schmitt, the panel's chair and president of Rensselaer Polytechnic Institute, called the current state of U.S. technological competitiveness "a grim picture" and urged that "implementation of a national technology policy, establishing a rationale and guidelines for federal action, should receive the highest priority."

George Bush and Bill Clinton agree that technology will be the engine of the nation's economy. They agree that our educational system has to do a better job of preparing Americans for that economy, and they both advocate government investment in research and development. Bill Clinton says he wants to build a "high wage, high skill, high tech" economy and George Bush says he has a "high five for high tech." They both call their plans for supporting U.S. technology a "technology policy." And that's about where the agreement ends.

A Minimalist Approach

When George Bush ran for the presidency in 1988, he campaigned on the things that he would *not* do if elected. He said he would not interfere with the private sector, he would not propose a national health care system, and, of course—"read my lips"—he would not raise taxes.

Dan Goodgame, coauthor of the recent book *Marching in Place: The Status Quo Presidency of George Bush*, says that Bush's first term has been "intentionally rather than accidentally minimalist. . . . [H]e is darkly pessimistic about the government's ability to change things for the better." Bush's basic view of his job as president has been to conduct foreign policy as the world's leading statesman and commander-in-chief of

the world's most powerful military, and let nearly everything else take its own course.

Thus Bush's record of support for high technology, says David Mowery, a University of California economist, has been "confusing and chaotic." But Cindy Beltz, a researcher on technology policy at the American Enterprise Institute in Washington, D.C., notes that the president has begun to see the light. "There has been an educational process on high tech in Bush's first term," she says.

That education may be too little, too late. Unfortunately for Bush, the economy has gone sour at precisely the time he must ask the electorate to give him a second term. Three million more people are out of work now than when Bush was elected, and in some regions the economy remains in its worst slump since the Great Depression. Especially ominous for the nation are the substantial unemployment levels in high-tech states like Massachusetts and California. The U.S. gross domestic product has been growing at a frail average of just over 1 percent per year, not enough to create the 15 million new jobs Bush promised in his 1988 campaign.

Even worse for Bush, the current recession is the nation's first stubborn downturn for white collar workers, and it has hit technically skilled engineers and middle managers especially hard. Many of these voters are terrified over the frequent pronouncements from economists that a large percentage of lost management jobs won't return because the U.S. economy is undergoing a profound post-Cold War restructuring. Insecurity is breeding frustration and fear.

Consequently, many middle-class professionals, some of them loyal Republicans in the past, are either planning to vote Democratic or backing the quixotic, on-again-off-again Ross Perot. Because "four more years" appear economically unpalatable to these voters, alternatives to Bush—despite the "trust" issue dogging Clinton and the low probability of a Perot victory—are taken seriously.

Bush began his first term with a troika of economic advisers that became known as "the Iron Triangle" for its rigid allegiance to free-market ideology and opposition to government support of technology. Richard Darman (director of the Office of Management and Budget), John Sununu (then White House chief of staff), and Michael Boskin (chair of the Council of Economic Advisers) repeatedly shot down even modest proposals for more activist government. In 1989, for example, the three recommended an abrupt end to government backing of Sematech, the Texas research consortium of semiconductor companies half funded by the Pentagon. Bush backed down from that cut-off when confronted

GARY CHAPMAN is coordinator of the 21st Century Project (based in Cambridge, Mass.), an endeavor of Computer Professionals for Social Responsibility to investigate new directions for science and technology policy in the post-Cold War era. He edits the CPSR Newsletter and was co-editor of *Computers in Battle* (Harcourt Brace Jovanovich, 1987).

with a bipartisan protest from Congress.

Shortly afterward, Bush fired Craig Fields, then director of the Defense Advanced Research Projects Agency, when Bush advisers decided that Fields's penchant for funding nonmilitary R&D was pushing DARPA too close to an "industrial policy." High-tech business leaders were angered by Fields's dismissal, and then perceived an insult added to the injury when Boskin said publicly, as a reflection of his faith in the free market, that "it doesn't matter if the United States produces computer chips or potato chips." Bush intensified the dismay of high-tech executives and researchers with his amazement over a grocery-store checkout scanner.

Ironically, even the most awesome display of American technological capabilities, and Bush's chief claim to presidential leadership—the Desert Storm campaign to eject Iraq from Kuwait in 1991—only intensified criticism about government technology policy. The weapons gadgetry demonstrated by the U.S. military contrasted with the declining competitiveness of the country's commercial high-tech products in the global marketplace, and the priorities of government investment were increasingly questioned. Moreover, the overwhelming superiority of U.S. weapons technology in the war against Iraq allowed Americans, in a post-Cold War world, to set aside decades-old concerns about national security and turn their attention to domestic problems.

A Policymaker in Spite of Himself

Bush has largely adhered to the free-market principles of his ideological advisers and conservative voting base, doing his utmost to "get out of the way" of industrial investors and decision makers. "I trust American entrepreneurs, engineers, and scientists, not government bureaucrats, to build the future high-tech economy," he told workers at the Superconducting Supercollider site in August. And he has been steadfast in his refusal to allow government to "pick winners and losers" among businesses.

But Lewis Branscomb, professor of technology and public policy at Harvard's Kennedy School of Government, points out that "Bush is in the curious position for a politician of having done more than he promised" in support of a government technology policy. Allen Bromley, the White House science adviser and head of the Office of Science and Technology Policy, produced a



'... What do you mean, I'm as sound as a dollar?..'

document in 1990 entitled "United States Technology Policy"—a title that would never have made it through the Reagan White House—that plainly argues for government investment in technologies to advance national economic competitiveness. Bush promoted and signed into law—with the help of Sen. Al Gore (D-Tenn.), now the Democratic vice-presidential candidate—the High Performance Computing and Communications Act. This legislation funds a five-year \$3 billion investment in what Gore calls "data highways," a computer-network analog to the national highway system and the largest government R&D program in the history of U.S. computer science.

The Bush administration's programs in science and technology also include major initiatives such as the Human Genome Project and the Advanced Battery Consortium. And Bush has at least tolerated the development of efforts like the Advanced Technology Program under the Department of Commerce, which helps fund non-military technological innovation through government-industry partnerships.

Ironically, says Branscomb, "all the elements of an adequate technology policy are already part of the Bush administration—except coordination, a clear rationale, sufficient funding, and political will." But senior technology officials in the Bush administration such as Bromley and Robert White, undersecretary for technology at the Department of Commerce, insist that the president has a coherent technology-development strategy. They point out that federal spending on "generic, precompetitive" research has reached record levels, up 44 percent in the four years that Bush has been in office. Bush has increased funding for math and science educa-

Clinton's technology initiatives are far more cautious than either side would have voters believe.



tion, and he has pledged to double the budget of the National Science Foundation budget and boost support for his major science and technology initiatives such as the Human Genome Project and the supercollider.

Bush officials also argue that the country's problem with technology is not the R&D that's being done but the poor dissemination of the results into commercial products. Early in 1992, the administration launched the National Technology Initiative, a set of policies aimed at moving technologies out of federal laboratories and into the private sector. The Department of Commerce now has seven Manufacturing Technology Centers around the country to help stimulate innovation among small and medium-sized businesses. Commerce has also implemented a State Technology Extension Program, which works jointly with state-level agencies to support development of regional clusters of technologically advanced manufacturing.

Meanwhile, of course, the Bush administration is promoting policies to stimulate private investment in technology. The president repeats at every chance his commitment to decrease taxes, government spending, and regulation—policies he claims are essential to economic growth—although all three have increased during his first term. The president says that his pursuit of free trade in negotiations with Japan and the completion of the North American Free Trade Agreement with Canada and Mexico will help invigorate the U.S. economy as well. He favors making the R&D tax credit permanent, and he has a well-known and passionate attachment to a cut in the capital gains tax. Finally, Bush

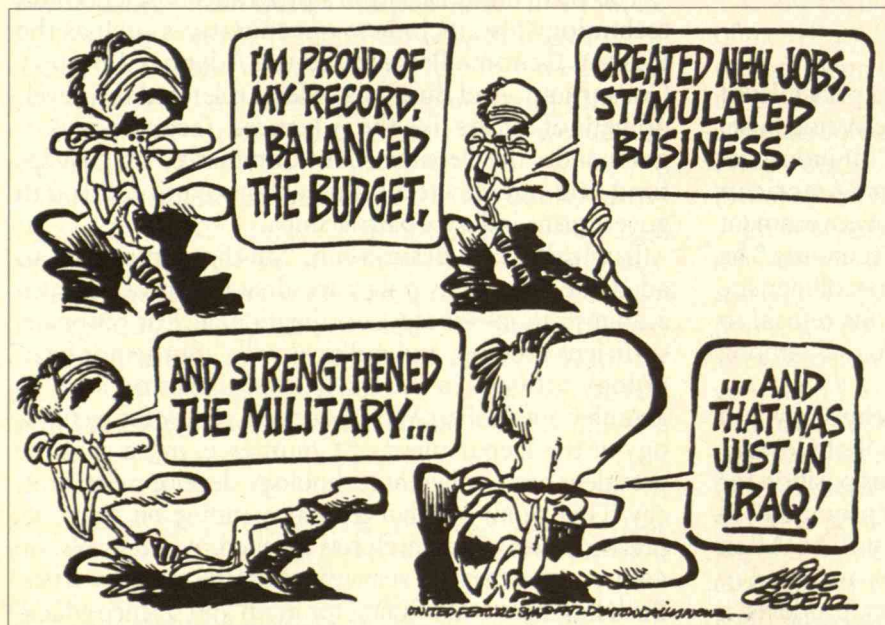
has endorsed two of Vice-President Dan Quayle's pet projects: eliminating regulations unfavorable to business (through Quayle's Council on Competitiveness) and reforming product-liability law to relieve the private sector's burden of court judgments, legal fees, regulatory compliance, and insurance.

Naturally, many high-tech business executives echo Bush's faith in their entrepreneurial energy. Roger Sippl, founding president of Informix Software, a database application company in Silicon Valley, says that what Bush needs most is a "Republican Congress to turn things around." But even GOP leaders admit that the chance of voters putting a Republican majority into either house of Congress this fall is close to zero. And the prospect of four more years of legislative deadlock is having a corrosive effect even on previous Bush supporters. For example, several high-tech leaders in Silicon Valley, including John Sculley of Apple Computer and John Young, president of Hewlett-Packard, have endorsed Clinton. Both men supported Bush in 1988.

Skills and Infrastructure

Many people, even conservatives, regard Republican technology policy as an ad hoc collection of programs that reflect a coherent framework only when viewed with a charitable eye. In contrast, the Democrats claim that their own plans are deliberately and carefully constructed. They are advertising their candidate's strategy for the economy as a comprehensive prescription.

Renowned for his multi-point plans that are so ambitious and thorough as to occasionally glaze the eyes, Clinton calls his opponent's strategy for the economy "limited and dated." The Democratic candidate frequently refers to the policies of Germany and Japan, such as government-industry partnerships and targeted technology investment, that are alleged to have stimulated increasing technological strength and enviable economic growth. Clinton notes that these policies have flourished even under "conservative" governments. He suggests that there is a consensus in the modern industrialized world about the need for government investment in basic technological "infrastructure"—one of his favorite words—and that only the United States government has abstained, to the country's disadvantage.



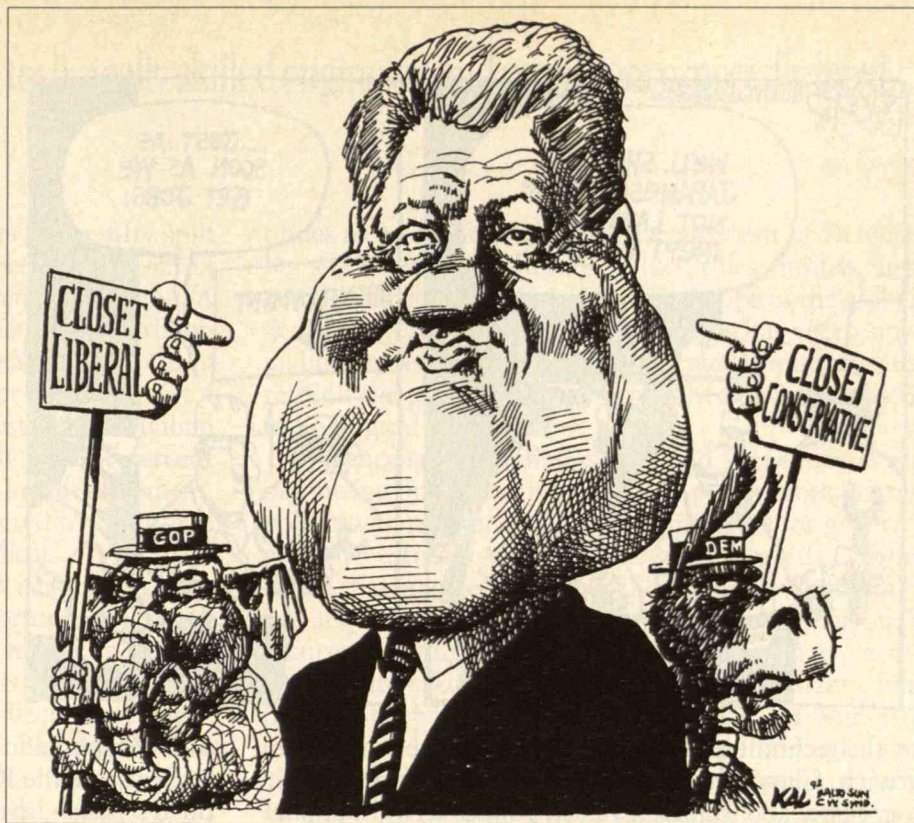
Clinton has adopted many of the ideas of his old friend and economic adviser, Robert Reich, the political economist from Harvard University. Reich, who first met Clinton when they were Rhodes Scholars at Oxford, has two basic arguments with regard to the kinds of investment needed in a national economy so that it profits from global economic transformation. First, says Reich, there are only two components of a country's economy that cannot be relocated easily or in large numbers—its people, and its public infrastructure such as roads, communications technologies, and educational institutions. Everything else, especially capital and ideas, can readily be moved overseas. Regulation that puts restraints on things that can move, argues Reich, is not as economically fruitful as investing in the things that cannot move.

Second, Reich and Clinton respond to critics of government spending by arguing that government, and industry for that matter, spends money on the wrong things. Rather than argue over private versus public investments, as he asserts is the preoccupation of most economists and business leaders, Reich prefers to view the economy in terms of consumption versus investment. He maintains that *both* sectors spend too much on consumption and too little on investment.

Building on this intellectual foundation, Clinton has proposed a program for investing in "skills and infrastructure." Taking another idea from Reich, he has suggested a federal budget divided into three separate sub-budgets: one for past obligations such as interest on the national debt; one for present obligations like entitlement programs and Social Security; and one for "future obligations" such as education and investment in public resources that ultimately pay off in better productivity, growth, and quality of life. Clinton's program calls for a \$200 billion increase in investment over four years in the broad category of skills and infrastructure, to be paid for by cuts in the defense budget and increases in taxes on the wealthy.

A Six-Point Policy

Ira Magaziner, a business consultant who is one of Clinton's chief advisers on technology policy, parses the governor's plan for technology into six components. First is a \$20 billion per year investment in physical infrastructure, involving elements such as a national high-speed



rail system; a new national information network with links to every home, business, and school by the year 2015; environmental technologies (stressing alternative energy sources and energy independence); and roads, bridges, ports, and public buildings. According to Magaziner, a Clinton administration would require matching funds from either private or public (state or local) partners for these projects, so that the total annual investment could approach \$40 billion.

Second, Clinton has endorsed the idea of a new civilian technology agency, modeled on DARPA, to help support investments in generic, precompetitive technological research. The details of this agency have yet to be worked out, but Magaziner says it would be funded at about \$5 billion per year, with the money coming from cuts in the Strategic Defense Initiative ("Star Wars") and from discontinued nuclear-weapons testing programs.

The research agenda for this agency, determined by advisory panels of nongovernmental experts, would be aimed at fostering "critical technologies"—a phrase that has come into vogue in Washington. Lists of such technologies, referring to those that are considered essential to the nation's security or economic competitiveness, have been circulating for years now and have acquired broad support; they typically include high-speed chips and computers, flat-panel displays, advanced materials, and biotechnology.

Education is the third part of the Democratic package, with increases in funding for schools, and a proposal to require companies to provide continuing education and retraining for workers, all aimed at new skills imposed



by the technological transformation of the workplace. Fourth, Clinton has proposed that a president's adviser for science and technology be appointed to the National Security Council and the Council of Economic Advisers. Fifth, he is promoting a Technical Extension Service, modeled on the venerable Agricultural Extension Service, to provide technical expertise to small businesses. He wants to expand and intensify the Bush administration's program for transferring technology from the federal labs to the private sector. And finally, like Bush, Clinton supports a permanent R&D tax credit. As a substitute for Bush's proposal for a cut in the capital gains tax, however, Clinton offers a "targeted investment tax credit" and a 50 percent tax exclusion for businesses making long-term investments that create jobs.

Perhaps the most controversial proposal—other than the total expense of these programs—is the Clinton plan for a new civilian technology agency to supplement DARPA (whose funding would remain intact). White at the Department of Commerce claims that "DARPA works because it has a customer—the Pentagon—with a lot of money to spend. But who is the customer for a civilian technology agency?" And Beltz at the American Enterprise Institute says she is skeptical that the civilian agency could be protected from the pork-barrel politics and micromanagement so rampant in Congress.

Magaziner responds that the "customer" will be the economy as a whole. He says that the agency could be protected from micromanagement by a program budget that is "voted up or down" by Congress, exempt from line-item tinkering. And Congress's predilection for pork-barrel funding could be avoided by appointing agency directors who are non-governmental experts sensitive to national technical needs, and by imposing a requirement that program participants share costs.

But another question is why Clinton would need a civilian technology agency when he has endorsed the efforts of Sen. Jeff Bingaman (D-N.Mex.) to make DARPA more of a "dual use" agency for fostering technologies that can be applied to military and civilian needs alike. Bingaman has introduced legislation this year that would push DARPA toward more commercial technology development and restore the agency's original name by dropping the word "defense." He said in an interview that he thinks federal budget deficits will prevent the introduction of a new technology agency.

Critics of government investments in critical technologies—whether by DARPA, ARPA, or some new entity—often point to the

case of high-definition television (HDTV). During the last years of the Reagan administration and well into Bush's watch, the American Electronics Association conducted a huge lobbying campaign to attract government funding for HDTV research. The AEA warned that this technology was the "last stand" of the U.S. consumer-electronics industry, and would also provide benefits for the military. But because of antipathy to government intervention in the economy, the White House balked.

Now there is general agreement that the government's resistance to the lobbying effort was a good thing. The delay allowed U.S. researchers to produce a digital standard for HDTV that is now considered state-of-the-art, ahead of foreign competitors. If the government had adopted a different standard prematurely, the argument goes, it would have picked a "loser." Proponents of Clinton's program say HDTV is a bad example because it isn't generic or basic enough—meaning it was already too close to a product when the AEA started its campaign, and government support would have amounted to a straightforward subsidy. Clinton's advisers even repeat the mantra that the government shouldn't pick winners and losers in technology. But any attempt at drawing a distinct line between "generic" research and government endorsement of a technology may be difficult.

Tunnel Vision

On close examination, Clinton's technology initiatives are far more cautious than either proponents or opponents would have voters believe. Clinton will reportedly seek no cuts in current Star Wars funding, for example, only cuts in the increases planned by Bush. The Clinton campaign has denied plans for cutting any other Pen-

The current recession has hit technically skilled engineers and managers especially hard.



tagon R&D program, and advocates a fifty-fifty split between military and civilian R&D spending, a mere six percentage points away from the present distribution. A Clinton administration would still spend over a trillion dollars on defense in the next five years, with a cut in spending from Bush's proposed level of only about 4 percent. The annual \$5 billion suggested for a civilian technology agency will represent only about 6 percent of the total federal outlay for research and development. And the agency is meant to be directed by high-tech business leaders, hardly a group of radicals.

For some people such plans bespeak a failure, by both candidates, to seize monumental opportunities. Randall Forsberg, director of the Institute for Defense and Disarmament Studies in Cambridge, Mass., urges the next administration to move toward "collective security" arrangements with other nations, including Russia. "The United States could cut annual military spending by 50 percent over the next few years and as much as 80 percent by the turn of the century," she recently wrote in the *Boston Review*. "Ultimately, the savings from a fully cooperative approach could come to \$180 billion per year over and above the \$30 billion cutback now planned by the Pentagon."

The fact is that the current "infrastructure" of government-sponsored technology programs not only con-

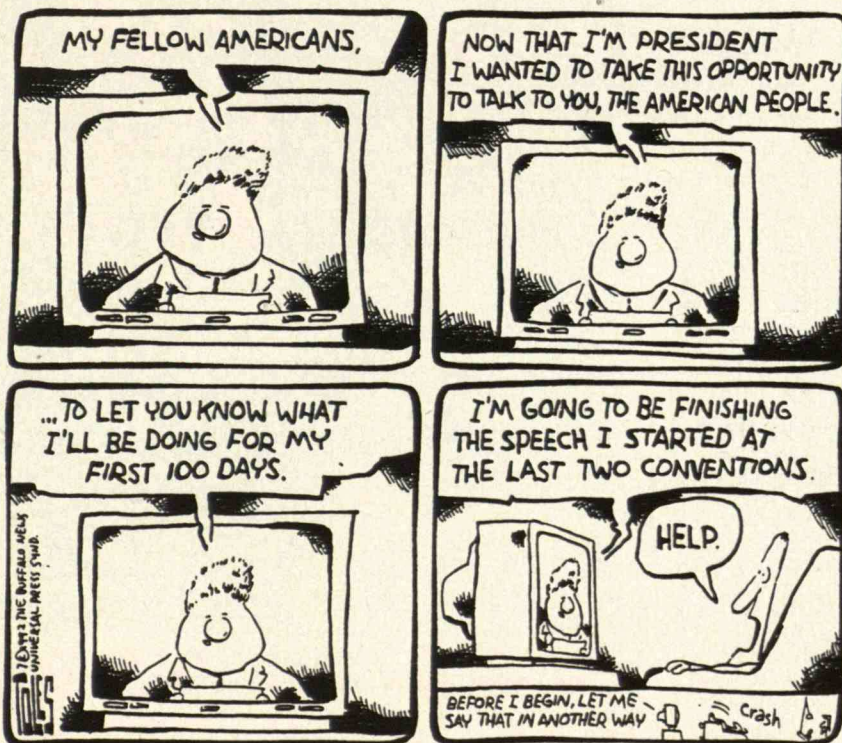
tinues to be dominated by the Department of Defense but still relies on institutions, values, rules, models, and people shaped by the Cold War. The scope of the global geopolitical change of the last few years has yet to sink in. But we clearly have an unprecedented opportunity to rethink the purpose and direction of publicly funded technological development.

Evidence suggests that as the Cold War fades as an organizing principle for technology policy, pork-barrel politics will rush in as the default rationale for government investment—unless a new set of goals can be found that engages the public. So far, no new rationale has acquired the comprehensive power of "national security," though there are candidates such as "economic competitiveness" and environmental quality. But the transition to a new era beyond the Cold War will require an adroit, flexible, and forward-looking leader. "The vision thing" will become more important than ever, as will the resolve to break attachments to old ways of thinking.

It's not clear whether such bold leadership is possible in the present political landscape. But even a conservative like Edward Hudgins, director of economic policy at the Heritage Foundation, sees the opening for a new discourse about technology and "the ethical question."

At the moment, however, technology is discussed less in terms of ethics and more with regard to how it can contribute to economic growth and national power.

Neither candidate has offered innovative proposals for democratizing technology policy-making or reducing citizens' alienation from government. Workers, for example, are viewed as beneficiaries of the plans of the elites—technological entrepreneurs, experts, and government officials—rather than as real participants in the development of technology and the strengthening of the economy. The rule of the meritocracy, in driving the public and private sectors alike, goes unquestioned in this election. But only when this rule is seriously reexamined will technology truly be able to serve the full range of human aspirations. ■



By ARIELLE EMMETT

Where East Does Not Meet West

Despite evidence that Chinese herbal methods can help combat cancer, the world's oldest and largest pharmacopoeia continues to be shunned by the U.S. medical establishment.

JEN Ma-Li's survival was a death sentence commuted in the last moments by a bold turn in strategy. In 1980 Ma-Li checked herself out of a leading Taipei cancer ward and went south to Tainan to seek treatment for her stomach cancer from a traditional Chinese physician.

Though Ma-Li, then 50 years old, had lost 30 pounds from her already delicate figure, she followed her new doctor's exacting prescriptions to the letter, taking as many as 90 bitter and fragrant herbal and animal medicines each day while avoiding bamboo shoots, squid, celery, peanuts, goose, eggplant, and citrus fruits. Each morning she got up with her husband to practice T'ai chi chuan exercises and sing Chinese opera under the bougainvillea in Sun Yat-Sen Memorial Park.

PHOTOGRAPHS BY PAULA LERNER
SPECIAL THANKS TO TOM TAM OF THE
LEA TAM ACUPUNCTURE CENTER





This anticancer recipe—containing close to a dozen flowers, roots, and insects—is among the most common tumor-fighting formulas prescribed by Chinese herbalists.

Today, at age 63, Ma-Li is cancer-free. The cause of her survival—and the near spontaneous remission of her tumor—remain unexplained. But Ma-Li believes that her physician's skills and the herbal medicines played an important role in her recovery.

And she is not alone: a sizable body of anecdotal evidence, as well as laboratory and clinical research conducted recently in the Orient, suggest that Chinese herbal preparations developed over the past 2,500 years may enhance the body's ability to seek out and destroy cancer cells.

Yet Western researchers, unimpressed by such evidence, continue to regard these "jelly herbs," crude powders, and bitter potions as little more than snake-oil elixirs. On the surface, the dispute seems to revolve around Eastern research practices. Westerners frequently complain about antiquated Chinese labs, inadmissible methodology, and difficulties involved in studying herbs in their crude, combined forms.

But the problem may be rooted in the underlying clash of cultures and incompatible medical philosophies. While traditional Chinese medicine uses a "shot-gun-shell" approach, exposing the patient to a beguiling mixture of herbal prescriptions to enhance the immune system's ability to fight cancer, Westerners tend to search for a magic bullet, a single, purified compound that will single-handedly kill targeted tumor cells.

Modern Tests of Ancient Methods

Proponents of the Eastern approach have been emulating Western-style research practices in order to show the efficacy of these complex herbal mixtures. In fact, researchers at the Chinese Academy of Medical Sciences (Beijing), the Nanjing College of Traditional Chinese Medicine, the Shanghai Institute of Materia Medica, and the National Cancer Center Research Institute of Japan, among others, have demonstrated that certain herbal combinations can fortify the immune system to inhibit tumors and complement the cancer-killing action of Western chemotherapy and radiotherapy treatments.

Researchers at the Nanjing College of Traditional Chinese Medicine, for example, have reported that the Chinese herb *isatis* enlists the aid of macrophages—wandering cells that engulf unfamiliar substances—and invokes other immune-system functions to fight tumors in mice. Certain compounds extracted from the herb

also boost the immune-system response to tumors in humans, in particular accelerating the production of interferon, a natural substance that stimulates the production of cancer-killing white blood cells. And clinical tests conducted at the Cancer Institute and Hospital at the Chinese Academy of Medical Sciences show that two Chinese herbs, *astragalus* and *ligustrum*, offset adverse side effects in patients undergoing chemotherapy by restoring immune-system function, protecting bone-marrow production, and maintaining an adequate white blood-cell count.

Sun Yen, a Western-trained medical oncologist at the Chinese Academy of Medical Sciences, reports that patients receiving radiation therapy for throat cancer were aided by a combination of traditional Chinese herbal medications known as *bu xue yao*, which translates as "drugs for stimulating and nourishing the blood." In fact, in one long-term comparative trial, the five-year survival rate among those who received the herbs along with standard radiation treatment was twice that of the group receiving radiation alone.

The Sum of the Parts

Despite these and other promising results, however, Chinese and Japanese research has elicited scarcely a murmur from oncologists in the West. The silence is especially apparent at U.S. cancer research institutions, where chemists have recently focused on research that is parallel to, but completely independent from, herbal medicine. Their goal is to screen plants and microbes for potent and, in many instances, toxic antitumor agents that can be developed by U.S. pharmaceutical companies. Thus far, the research mindset—and the strict protocols established by the Food and Drug Administration (FDA) for drug testing and drug purity—have precluded widespread investigation of the comparatively nontoxic Eastern herbal combinations as drugs.

"Drug companies here are extremely motivated to develop effective new chemotherapeutic agents," observes P. S. Venkateswaran, a medicinal chemist at the Fox Chase Cancer Center in Philadelphia, who is studying the effects of whole-herb extracts against the hepatitis B virus and its associated liver cancer. But the direction of drug-company research is to isolate single, biologically active agents according to FDA protocols, he says, not to look at the complex molecular actions of multiple compounds within a whole herb.

ARIELLE EMMETT is a science writer based in Wallingford, Pa.

A search for new anticancer drugs was stalled in the 1980s when Western scientists lacked significant new leads, claims Randall Johnson, director of biomolecular discovery, Smith Kline Beecham. "For 10 years the whole focus was on interferon and other immunotherapies. But these haven't worked."

The discovery of taxol, a purified molecule from the Pacific Northwest Yew that cures ovarian cancer in a remarkable number of cases, has helped renew U.S. interest in natural anticancer substances. The National Cancer Institute (NCI), for example, embarked on an aggressive worldwide search for new antitumor drugs five years ago in anticipation of more sensitive tests to screen for anticancer and anti-HIV substances. Since the new screens were initiated in 1990, NCI has literally beaten the bushes and stripped the bark from Madagascar to China, testing as many as 10,000 natural substances each year in the hopes of finding potent compounds akin to taxol.


But while it is not uncommon for NCI-sponsored botanists to consort with witch doctors and healers to learn about the secrets of herbal medicine, NCI will study neither herb combinations nor even whole single herbs. Instead, taxonomists place specimens in bags and containers and ship them back to NCI's natural products repository in Frederick, Md., where compounds are chemically extracted. Crude extracts that show some selective antitumor activity in primary tests are then classified and purified to their barest molecular components.

"While my personal feeling is that some of these herbal preparations are effective—80 percent of the world's population depends on them—our interest is in trying to isolate the drug from the preparation, rather than taking that preparation and trying to apply it," said Gordon Cragg, chief of the Natural Products Branch at NCI.

Unfortunately, Chinese medicine doesn't work with "pure" ingredients; its claims to efficacy lie in a complex interaction between many substances. Chinese traditional pharmacology identifies primary, secondary, assistant, and targeting components in each preparation, which may consist of anywhere from 4 to 12 individual herbs. "All the herbs work with a mixture of compounds," affirms Wesley Shiu, chair of the Department of Clinical Oncology at the Chinese University of Hong Kong. "You have to study the herbs in a group," he said.

Isolating the ingredients can actually deny researchers the knowledge they seek. Koji Nakanishi, a Columbia





Red Sage
Root

Bulb of Chinese
Tulip

Chinese
Angelica Root

Immature Bitter
Orange

Zedoary

University natural-products chemist, cites work conducted by Osamu Tanaka, a professor of pharmacy at the University of Hiroshima, who found that certain biologically active herbal compounds, when separated and purified, became totally inactive. In one study, "one fraction of a compound had no activity but contained naturally occurring agents that, when combined with another fraction, increased its solubility and hence permeability into membranes," Nakanishi says.

James Duke, a botanist at the U.S. Department of Agriculture (USDA), points to similar evidence of chemical synergy in the mayapple, a plant whose compounds or synthetic analogs have been used to treat lung cancer, testicular cancer, and herpes. Reviewing published research on six active substances in the mayapple, Duke found that an extract of the whole herb "is proportionally four to five times more potent against herpes than any of the individual compounds."

Seeking Reproducible Results

Duke's research, which tries to account for nature's biological complexity, stands in stark contrast to that of most other Western researchers, who believe that the only way to study cause and effect is to look at compounds that are pure and consistent from batch to batch. "There are stupendous mixtures of hundreds or even thousands of different chemicals within one herbal preparation, and it's very difficult to determine the quality of the preparation or if it's exactly like another," explains NCI's Gordon Cragg. This makes for problems in obtaining the reproducible results the FDA requires before approving a drug even for investigational status and testing.

It's not surprising, then, that Oriental laboratory and clinical trials of herbal medicines have thus far failed to satisfy the demanding criteria of the West. In fact, merely separating and purifying the substances can be an enormous challenge. Yu Jing Jie, an NCI consultant and associate professor of Beijing Union Medical College, points out that many research institutes in China lack the money and facilities to do technologically sophisticated modern studies. "We have old equipment—hand scales, for example—and because we lack money to buy advanced equipment, the speed of the studies is very slow," she says.

Having spent several years in China documenting traditional healing practices for the Chinese government, NCI's Yu Jing Jie believes that empirical data on herbal

Chinese Herbal Medicine: A Primer

UNLIKE many folk-medicine traditions, Chinese herbal medicine has been codified in a complex pharmacopoeia of specific drug interactions and effects. One of the earliest surviving pharmaceutical texts, known as the *Shan Hai Ching*, dates from about 250 B.C. and describes the first medicinal uses of 68 plants and animals—among them, cinnamon, angelica, peony, jujube, dragon bone, and talc.

Today a dictionary of traditional herbs known as *Chung Yao Ta Tsu Tien* identifies 5,767 medicinal substances for physical conditions ranging from stomach aches to pregnancy and cancer. However, practitioners commonly choose from the fewer than 300 most common herbs for their prescriptions. Drug properties and actions are based on empirical observations and a metaphorical (and at times cosmological) language of disease and health states. For example, another early text, the *Shen Nung Pen Tso Ching*, identifies three broad classes of herbal drugs: the “imperial” class of nontoxic and rejuvenating herbs; a

“ministerial” class with toxic or nontoxic effects promoting mental stability; and an “assistant” class with toxic properties used for treating various diseases.

Chinese pharmacology also describes therapeutic effects based on a theory of fundamental body and organ conditions known as “the four essences” (cold, cool, warm, and hot), drug “flavors” (pungent, sweet, sour, bitter, and salty), and “directions” or targeting effects (“ascending, descending, floating, and sinking” drug actions). A drug categorized as “hot,” for example, might be used to remove phlegm or restore vital energy (yang) to the kidney; a bitter drug might dispel heat or dampness in the body; a “sour-warm” combination might have astringent effects, which could be used to treat incessant diarrhea.

These phenomenological descriptions may seem even more mystifying when they identify the interactions of multiple herbs. Traditional physicians may prescribe up to a dozen or more in combination at any one time, according to John Shen, a New York-based acupunc-

turist and traditional Chinese physician.

The herbal combinations contain only very weak concentrations of cell-killing drugs, according to Robert Krueger, a pharmacognosist (one who studies crude drugs) at Ferris State University School of Pharmacy in Michigan. “If you want to give an equivalent herbal dose of the purified crystalline product that Western medicine usually prescribes, a person would have to consume bales of the plant,” he says. The low doses of active substances is one of the reasons that herbal medicines exhibit few, if any side effects.

Shen, who was trained in traditional medicine at Shanghai Medical College in the 1930s, suggests that herbal combinations are much more potent than the sum of the parts. Moreover, Chinese medicine can never be understood in Western, mechanistic terms. “Most Westerners mistake Chinese medicine for a technique—such as acupuncture, meditation, or herbs,” he says. “But the most important aspect of traditional Chinese medicine is diagnosis.”

—ARIELLE EMMETT

medicines are clear. "We have plenty of proof," she states categorically, "that we can improve cancer patient survival rates using traditional Chinese medicine."

Some in the West suggest that such claims are based more on an emotional attachment to traditional medicine than on sound evidence. "Clinical trials from China and Japan are not considered to be definitive," says Smith Kline Beecham's Randall Johnson, who is pursuing development of topotecan, a powerful chemotherapy drug against ovarian, lung, and certain bowel cancers that is derived from substances isolated from the Chinese tree camptotheca. "The reason we don't get overwhelmed by reports of these incredible Asian response rates is that we've seen them for 50 years. Even when I read the results from Japanese trials of camptothecins [from which topotecan is derived], the response rates are too good to be true." He adds that "Asian researchers know how to do good clinical trials. But there's an aspect of cancer that causes them to get emotionally involved in the treatments they try to evaluate. They become true believers."

Johnson does not apply this comment to Western scientists, although he might as well. For instance, mitotic poisons—agents used to interfere with the reproduction of both tumor and normal cells—have side effects that suppress the immune system and can make life virtually unbearable for cancer patients. But they have never been seriously questioned by mainstream medicine. Studies focus instead on finding agents that produce "acceptable levels of toxicity."

"Our people blithely go along and ignore herbal medicines, giving the patients something as bad as what they already have," argues USDA's James Duke. Even then, Western researchers focus on high-tech refinements of synthetic therapies rather than investigate the use of herbal treatments to help reduce the adverse side-effects of chemotherapy or radiation.

Hopeful Signs

The possibility that major oncology centers in the West will soon become more open to medical advances from the Orient is not great. John Shen, a leading New York-based traditional Chinese practitioner, points out that the philosophy behind Chinese herbal medicine is so fundamentally different from Western medicine that it is hard to find common ground. Chinese herbalists stress treatment of underlying bodily conditions rather than correction of symptoms and diseases per

se. They also stress custom care, based on the notion that each patient responds differently, and therefore devise different combinations of herbs on a case-by-case basis. Western medicine, by contrast, tends to look at statistical patterns of disease and patient response within broad populations.

Nonetheless, some hopeful signs are emerging. For instance, NCI has written a new set of protocols for clinical trials that are intended to encourage proponents of unproven cancer treatments to collect "scientifically interpretable data," which can then be used to evaluate research claims and fund follow-up studies. While "interpretable data" continues to mean exacting Western-style laboratory analysis and diagnosis, NCI will now accept pilot clinical data on "best cases"—isolated evidence of patient improvement on a case-by-case basis—instead of data derived exclusively from large-scale clinical trials.

This effort in itself represents liberalization. "We don't have resources to evaluate every claim made by practitioners," said NCI's Hawkins. "What we have are the resources to evaluate data from investigators who document and support their claims."

NCI has also recently introduced a \$20.5 million program to identify naturally occurring foods that could be concentrated or augmented into preventative anticancer concoctions—such as a specially prepared juice. Herbert Pierson, a toxicologist in the Diet and Cancer Branch of NCI's Division of Cancer Prevention and Control, reports that 22 contracts were awarded under this program in the past year.

One area of study looks at how plant chemicals already found in traditional Chinese and Japanese herbal medicine can block the action of certain carcinogens and hasten precancerous cells to return to a normal state. For example, green teas from the Orient are rich in antioxidants that block the action of carcinogens, according to NCI research. Also under investigation is garlic, which has been shown to reduce a person's risk of developing cancer of the esophagus.

But most encouraging is the optimism expressed by individual scientists and physicians about someday bridging the two worlds. For example, NCI consultant Yu Jing Jie is trying to set up cooperative programs for scholarly exchange between China's traditional medical colleges and NCI. "In much the same way that earlier surgeons and anesthesiologists were stunned by the results of Chinese acupuncture and massage," she says, "even the most dour Western critics may come to China and surprise themselves." ■



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2 Know your own strategic goals and technical capabilities. Consultant Jeff Staley of **Generics Group USA** showed *Technology Access* readers how to perform technology audits and develop "technology asset plans," so you can decide what to develop internally or source from outside.

Key new trend: Universities are "packaging" related technologies from more than one institution. And **Sandia's** Dan Arvizu says the nation's 700 federal labs are assessing their own core capabilities, as they respond to industry's needs.

3 Know your potential partners—and competitors. *Technology Access* profiles the tech transfer operations of companies and not-for-profits in all sectors, so you can benchmark your performance against the world's best—and be prepared to deal when an opportunity arises.

Note: Every article ends with an easy-to-spot "Access Block" complete with name, address, phone and fax numbers. You save time by calling direct to the source.

4 Expand your network of technology suppliers, users and partners. *Technology Access* will expose you to the full spectrum of innovators: universities large and small, federal and independent labs, medical centers—and companies.

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6 Scan the horizons. *Technology Access* will keep you from being blindsided—and alert you to unexpected opportunities. Information overload notwithstanding, it's critical to resist narrowing your focus. Biochemist Kathy Ku, **Stanford's** new licensing director, said, "*I depend on Technol-*

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Photographing the Mira

THE WORK OF LENNART NILSSON



e of Life

By JOELLE BENTLEY

WHEN he was 13, Lennart Nilsson pleaded with his father to buy him a microscope so that he could carefully examine his extensive collection of live insects. Along with the microscope, his father provided a 25-cent camera and urged his son to record what he saw. "I wanted to get close to everything, to see the miracle of life," says Nilsson, the now world-renowned scientific photographer who recently received an award from the International Center of Photography for "extraordinary lifetime work." The 25¢ camera soon led to a \$2 Kodak box camera, and the life-long process had begun. Since then, Nilsson's need to see things ever closer and in sharper detail has driven a relentless demand for better instruments. Collaborating with physicians and scientists, he has prodded the development of new technologies that allow him to capture the drama of life's fundamental processes.



THE WORLD'S FIRST PORTRAIT OF A LIVING FETUS, MADE IN 1965, SHOWS PART OF A FOREHEAD AND FACE (LEFT). IN HIS LAB (ABOVE), LENNART NILSSON USES A VARIETY OF CUSTOMIZED MICROSCOPES.

JOELLE BENTLEY writes on science and the visual arts. She is director of *Caduceus Fine Art*, New York, a gallery specializing in medical art.

NILSSON, 70, began his career under the tutelage of photojournalist Per-Olow Andersson in the 1940s. At first his interest centered on people, from the ordinary to the exotic. The photographer Edward Steichen included some of Nilsson's 1948 photos of life in the Belgian Congo in the legendary photographic survey *The Family of Man*, organized by the Museum of Modern Art in 1955. (Photo A shows an image from the Congo series.)

On a visit to Stockholm's Karolinska Institute in 1952, Nilsson came across three little bottles in an anatomy laboratory, each containing a human embryo about five to six weeks old. He was riveted by the fact that although the bodies were only about half an inch long, he could discern their eyes, arms, and even hands. The following year he brought three photographs of the specimens to New York while on assignment for *Life*. The editors published the images and implored him to continue with this work.



A

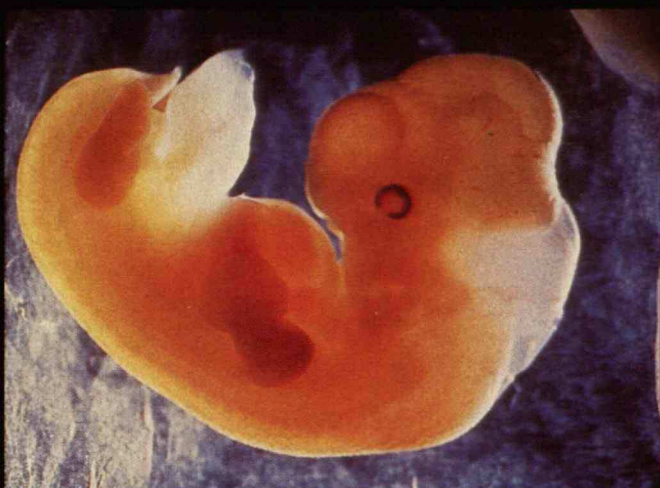
Nilsson resolved to photograph living fetuses. His lifetime collaboration with Werner Donne, an optics inventor, got off to a rocky start in 1956 when Nilsson assigned him the task of connecting a 1/8th-inch-wide electronic flash to an endoscope. The instrument is a cable-like device that can be inserted into the body to visualize internal surfaces such as the uterus. Nilsson still pales with disappointment when he explains how, after a year of preparation, the two used the endoscope to see a 16-week-old fetus sucking its thumb—but they were unable to make the flash work inside the mother's body.

Nilsson then turned to the German optical company Storz to produce a wide-angle endoscope that could be equipped with an external flash attached to glass fibers. These could carry light inside the body and illuminate it. In 1965, this endo-

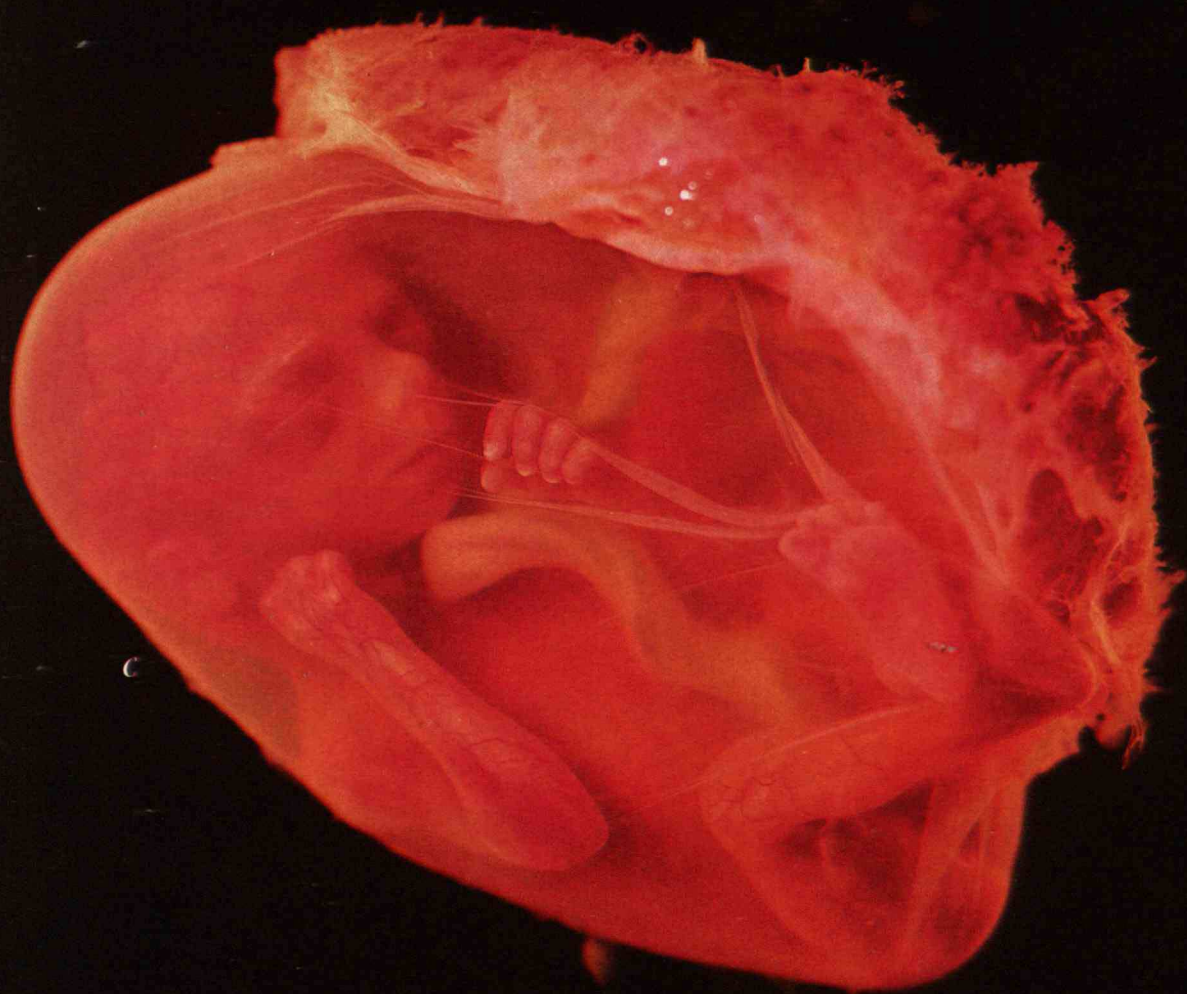
scope allowed Nilsson to produce the world's first portrait of a living fetus.

Not satisfied with the diminished clarity that endoscopic photography yields, Nilsson worked in his laboratory at the Karolinska Institute with fetuses from ectopic and hence unsuccessful pregnancies. *Life* published the resulting portfolio on human reproduction in a 1965 cover story, "The Drama of Life Before Birth" (B, C). The first edition of Nilsson's now-classic book, *A Child Is Born*, was also published that year.

His curiosity next led Nilsson to take photos of every part of the body, including pictures of the interior of blood vessels as they build up plaque, which can lead to heart attacks. In 1966, the smallest lenses available produced poor quality images. So Nilsson again enlisted Donne, this time to design a lens less than 1.5 millimeters across and with a picture angle of 160 degrees. Such a wide-angle lens has great depth of field—it can produce pictures in which all of the imagery is sharp—and yielded the clarity Nilsson sought. He inserted the resulting lens into blood vessels to photograph them during open-heart surgery.



B



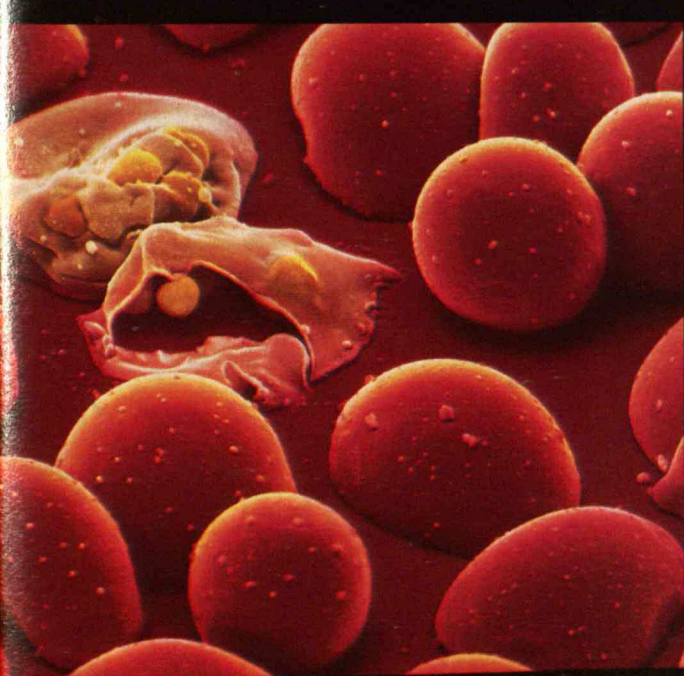


E

D



F



A LONG with his interest in medical imagery, Nilsson maintained an interest in nature photography. In 1968 he commissioned optics expert George Vogl and his assistant Bo Möller at Jugner Co. in Stockholm to build five lenses that would prove useful in both disciplines. The lenses were miniaturized, ranging in diameter from 0.5 to 6 millimeters, and they had excellent depth of field. Over the years Nilsson has placed these lenses in everything from a tulip (*D*) to the brain.

Today Nilsson's lab is equipped with a variety of customized microscopes. He turned to the Jeol company in Japan, for example, to produce a scanning-electron microscope with state-of-the-art resolution. Four years ago he became the owner of the prototype, which can resolve images to 0.7-billionth of a meter. Nilsson delights in the instrument's clarity, which he says is "200 times greater than natural light." That is possible because the wavelength of an electron beam is many times shorter than the average wavelength of visible light. A scanning-electron microscope image of a mosquito drawing blood (*E*), for example, shows highly defined ridges of skin.

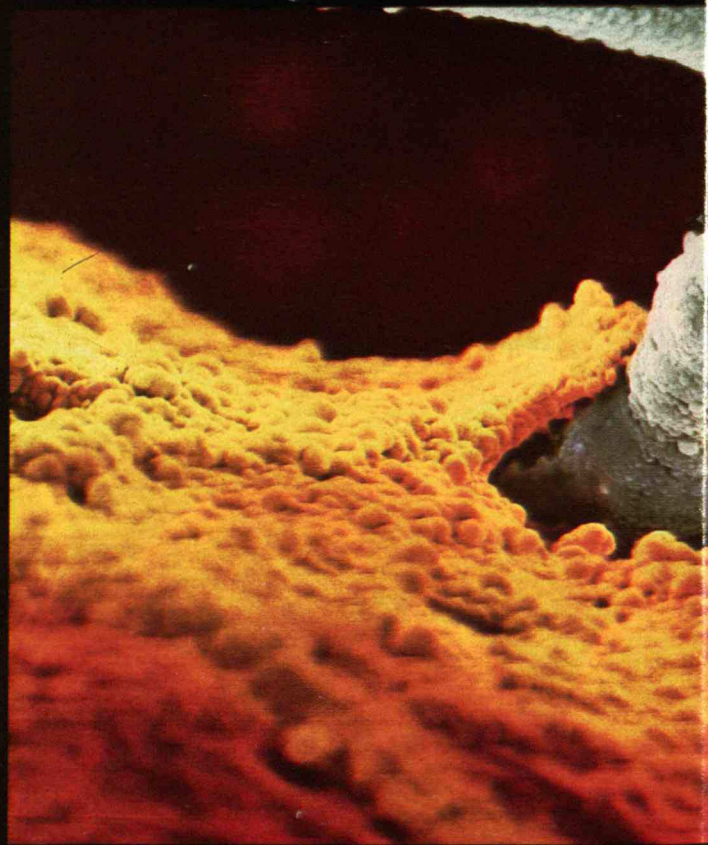
In his lab Nilsson has cultivated and preserved substances such as cancer cells and the AIDS virus. One specimen he grew led to a scanning-electron picture of red blood cells bursting apart to emit malaria parasites (*F*).

SINCE the 1980s Nilsson has focused scanning-electron and light microscopes on cultures to update his chronicle on human reproduction. Time-lapse photos of the process of fertilization depict an egg being swept along a fallopian tube (G), a sperm entering an egg's outer wall (H), and a fertilized egg dividing (I).

Nilsson also created a film on fetal development that aired on the public television series *Nova* for the first time in 1983. Now he is preparing another film, using a movie camera attached to an endoscope, to show conception actually taking place inside a woman's body. Every process can be made visible, he maintains, "if we have the right kind of optics." ■



G



H



A Supercollision of Interests

A scientific endeavor with a goal as pure as they come—to discover the fundamental laws that govern the universe—has become mired in the mundane governmental process that allocates research support. In May, the House of Representatives voted to terminate the Superconducting Supercollider, or SSC, an \$8.2 billion particle accelerator to be built in a 54-mile tunnel in Waxahachie, Tex.

The Senate came to the rescue in August, appropriating \$550 million for the SSC for fiscal 1993—\$100 million less than President Bush's request. At this shaky level of funding, even with the \$1.2 billion already spent on the SSC, the giant accelerator will not be ready for experiments for another dozen years. The project is under continual attack from segments of the scientific community that believe the resources allocated to particle physicists could be better spent, as well as from members of Congress who are looking for relatively painless ways to shrink the deficit.

This tentative "support" could bleed the SSC to death. Instead of choosing between two reasonable options—completing the SSC quickly, or canceling it and devoting the resources to other worthwhile scientific and technological purposes—we seem intent on doling out annual appropriations that are too small to construct the project efficiently and that make cost escalation inevitable.

The issue is not the SSC's affordability but its priority. How is the nation better served: by investing billions in one high-energy physics project, or by devoting these resources to other areas of research such as materials, biomedicine, and manufacturing technology that offer tremendous intellectual opportunity as well as much higher likelihood of contributing to the country's economic well-being?

Advocates of the SSC tend to avoid the priorities question. They appeal to the excitement of discovery in a field that has produced some of the most important triumphs of human understanding and that has in the past led to important technological applications. Secretary of Energy James Watkins has argued that

"it takes vision and courage to fund basic research" and that "the full payoff [of basic research] is often unclear." No one disputes these clichés or the scientific merit of the SSC. But enthusiasm alone does not justify ignoring resource constraints.

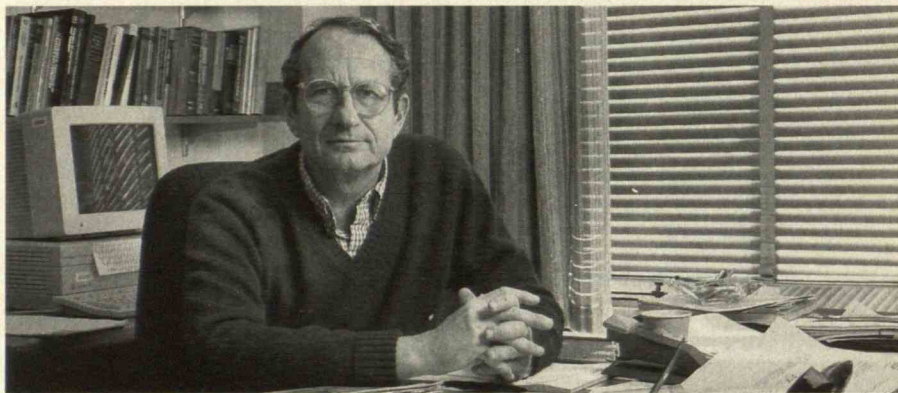
Proponents also engage in unsavory distortion of the SSC's potential economic benefits. Several Senators reportedly were persuaded to support the collider by the prospect of spinoffs in computers, medical systems, and high-speed trains. All these technologies would be better pursued through direct support.

In my judgment, the scientific benefits of the SSC relative to those to be gained from other research opportunities do not justify its cost, and I would cancel the project. Instead, I believe, we should adopt an international strategy. High-energy physics experiments are very

pay \$1 billion of the costs for a project that did not involve them in planning, site selection, or construction.

It is not too late to follow the international alternative. The European Community is already working on a much less expensive accelerator called the Large Hadron Collider (LHC), which will use an existing tunnel at Europe's jointly operated CERN laboratory near Geneva. The LHC could upstage the supercollider by conducting some of the important physics experiments—such as verifying the quark theory of matter—that U.S. physicists have been citing to justify the SSC.

The United States should propose that CERN be open to all nations. U.S. and Japanese scientists would collaborate with their European colleagues in planning and operating the LHC, with each country contributing \$1 billion toward it. We should also propose that the

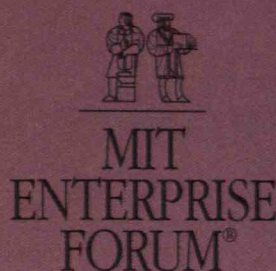


costly and provide fundamental knowledge that becomes freely available. It therefore makes sense for countries to cooperate in planning, building, operating, and financing these facilities. I recommended this strategy during the first five years of the SSC project, when I was member of its board of overseers.

Unfortunately, the high-energy physics community decided that to attract political support, it would promote the SSC as a major construction project and adopt jingoist rhetoric that stressed U.S. scientific dominance. But attracting foreign money to an "America first" SSC project has proved difficult. Japan correctly resisted pressure to

member nations of this new consortium agree to build the next major high-energy physics project in the United States (perhaps at Waxahachie) with joint planning and international financing. For its part, the United States would assure steady appropriations toward this project, say \$100 million per year for 10 years. This course of action would cost the United States \$5 billion less than the SSC—and that would pay for a lot of basic research. ■

JOHN M. DEUTCH, Institute Professor at MIT, was formerly provost and dean of science. He has also been undersecretary and director of energy research of the U.S. Department of Energy.



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Tapping Work-force Creativity

SHOULD workers participate in the design of new technologies they will eventually use? Given an opportunity to take part, can they make valuable contributions to the design process? On both sides of the Atlantic, growing numbers of researchers are answering these questions with a firm "yes."

The contemporary participatory design (PD) movement emerged in Norway in the early 1970s. Expanding on concepts of human rights that had arisen in the Scandinavian social democracies over several decades, computer scientists at the Norwegian Computing Center in Oslo enlisted workers in shaping new forms of computerized production used in the country's metals industries.

Public debates about these projects led to new labor/employer technology agreements as well as novel legislation governing the quality of working life throughout Scandinavia. For example, workers gained the right to veto the introduction of technologies that would diminish the quality of work life, such as electronic surveillance and the use of computers to segment jobs into even smaller pieces. PD offers a course of action through which workers can affirm the right to safe, satisfying jobs.

In the early 1980s, these initiatives were carried further in the ambitious Utopia project at the Center for Working Life in Stockholm, where union members sought to protect their traditional skills as computers were revolutionizing newspaper publishing. Rather than simply imposing the new technologies as a direct replacement for people, the Utopia project allowed skilled typographers to help shape the hardware, software, and social organization of the new typesetting systems.

PD has influenced the introduction of computers and software in banks, hospitals, schools, aircraft maintenance shops, government offices, and a variety of other settings. In one Oslo hospital that I visited, nurses had joined with university consultants to tailor a computerized work-scheduling program to suit a wide range of personal and group needs.

Users of this software profess a lasting sense of pride for having formed the system themselves rather than allowing outside "experts" to impose a new regime.

The success of PD in practical use is mirrored in its growing intellectual respectability. Books like Pelle Ehn's *Work-Oriented Design of Computer Artifacts* draw upon the results of PD experiments to offer a fascinating mix of technical proposals and social theory. At universities in Aarhus, Lund, Helsinki, Copenhagen, and elsewhere, the belief is growing that computer system designers can—and should—consider the impact of new technologies on workers at the outset rather than as an afterthought.

Meanwhile, the word on PD is starting to spread beyond the Nordic countries. The second Conference on Participation in Design, held this fall in Cambridge, Mass., brought together North American and European com-

Indeed, as PD becomes more professional and widely recognized, some supporters fear that it will become simply a technique for making things run better, rather than a tool for overhauling labor-management relations. As Kari Thoresen, a PD researcher at the Norwegian Computing Center, commented recently: "It is time to revive the democratic dimension of participatory design. Without democracy, we are left with just a number of methods for designing information systems."

At General Motors' new Saturn organization, for example, workers participate in a range of design and marketing decisions [see related story, p. 30.] But their freedom falls far short of PD ideals. I doubt that GM would permit a shop steward to stop the introduction of a new machine or system while its features are retailored to suit workers' interests—a freedom that Scandinavian labor con-



puter professionals, workers, and political activists. Some U.S. companies, hoping to boost productivity and employee morale, have begun looking into PD to see what it has to offer.

Because they lack the material resources and institutional power to do anything more at present, many PD initiatives are modest in scope; what is "designed" for the most part are computer interfaces, flexible features of commercial software packages, and information flows within organizations. These are worthwhile activities, but they do not directly confront factory and office technologies in a way that would fundamentally transform the workplace.

tracts now guarantee.

What would happen if democratic participation were carried deeply into technical realms where norms of efficiency, profit, and managerial control now govern? The mounting failures of our current systems of production suggest that we can no longer afford to ignore the creative contributions of all the players. ■

LANGDON WINNER, who has just returned from a year as visiting research fellow at the Center for Technology and Culture in Oslo, teaches science and technology studies at Rensselaer Polytechnic Institute. He is editor of *Democracy in a Technological Society* (Kluwer Academic Publishers, 1992).

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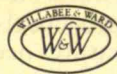
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Preventing Famine at Its Source

REPORTS of mass starvation in Somalia and the threat of widespread hunger across much of southern Africa have prompted by-now-familiar appeals for emergency food shipments. Unfortunately, the complicated logistics of procuring and delivering large-scale aid mean that food can never arrive in time to stave off a crisis once it is imminent. What's more, the urgent need to deal with the immediate problem obscures lessons that the West has repeatedly failed to learn: No country has moved from being famine-stricken to famine-free by receiving food aid. And no government is so poor that it cannot afford a famine-prevention system. Only by making emergency food

shipments as well as development aid conditional on fundamental changes in recipient countries can the world eliminate famine and avoid institutionalizing an ineffective international dole.

The basic measures needed to head off famine were enumerated more than a century ago by the Indian Famine Commission of 1883, whose findings still form the foundation of the successful Indian famine-prevention system. The centerpiece of that system is jobs: during an emergency, invoked when unemployment reaches a certain level, the government guarantees paid employment to all able-bodied people without an income. The government also releases stockpiled food to ensure that grain is readily available at a reasonable price.

A crucial spur to this commitment is public pressure: citizens use the press to complain of shortages and pressure their representatives to act. Because few members of parliament could expect votes from an electorate dying of hunger, the government takes action

well in advance of a food emergency. The result is that no food need be imported from abroad, and food hand-outs are kept to a minimum.

Although India is the finest example of a large-scale, efficient famine-prevention system, Africa has also seen its share of successes. In Botswana, the government immediately begins to buy food on the international market whenever there is a domestic shortfall. Year after year, the country has managed to cut rates of child undernutrition despite repeated droughts and production shortfalls that dwarf those in Sudan and Ethiopia, sites of recent large-scale famine. Any Western food aid to Botswana—and the country *has* received generous amounts—is regarded as a luxury that is used to replenish stocks, not as a necessary precondition for starting a relief program.

Cape Verde and Kenya have also coped with major food shortages because elected representatives have pressured the government for deliveries of cheap or free food purchased on the

world market. And Sudan in the 1970s and Zimbabwe in the 1980s relied on long-term grain-storage plans to meet short-term crises. Famine occurred when Sudan exported its reserves in 1984 and 1990, and when Zimbabwe ran down its stockpiles in 1990.

Under such conditions, donors often deliver aid with no questions asked because they wish to maintain good commercial or strategic relations with recipients. But while Western aid has a marginal effect once famine is underway, it does play a vital role in sustaining corrupt governments. Food aid sold to urban citizens who can afford to pay provides the single greatest source of revenue for Africa's poorest countries.

Meanwhile, rural populations become pawns in the domestic conflicts common to Africa, further undermining their chances of survival. Battles and raids destroy crops and livestock, and people driven from their homes are forced to become refugees. Governments fighting guerrilla movements stop people from migrating in search of



Donors of international aid must direct their gifts not only to feed but to nourish ordinary citizens.

jobs and more productive land, and armed conflict prevents the flow of food from surplus to deficit areas. During the great Ethiopian famine of 1983-5, the government bombed markets in rebel hands and prevented traders from transporting food to those who needed it. In Somalia today, clan-based militias are taking advantage of their ready access to cheap modern firearms to fight over land, water, cattle, trade routes, and international aid, again preventing food from reaching intended recipients.

Aid donors rarely consider the conduct of such internal wars and are indifferent to the extent that governments spend funds on weapons. And Westerners too often equate democracy with multiple parties while ignoring other pillars of a strong civilian society such as the press, judiciary, trade unions, and professional associations. Although donor governments have recently begun to cite progress on human rights as a criterion for allocating aid, the thinking on such issues remains depressingly superficial.

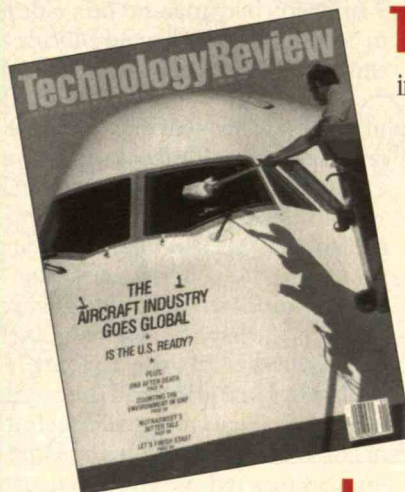
Most important, donors devote little thought to making assistance programs accountable to the supposed beneficiaries—citizens—relying instead on government-to-government contracts. Recipient countries should be required to enshrine in domestic law a clear obligation to provide famine relief, and award an independent watchdog agency legal powers to prosecute negligent parties. For their part, donors must guarantee advance food allocations to famine-prone countries rather than waiting for urgent appeals. Donors, too, should conduct public inquiries into the performance of relief programs to learn from past mistakes and discipline, dismiss, and even prosecute negligent officials. Finally, if development programs are to help consign famine to history, they should be subject to the same public scrutiny. ■

ALEX DE WAAL is associate director of London-based Africa Watch (a division of Human Rights Watch, headquartered in New York).

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Toward Renewed Reverence for Life

ENVIRONMENTAL changes caused by human activity divide into two major categories: alterations in the physical environment, such as depletion of the ozone layer; and the mass extinction of species and genetic varieties. The difference between the categories lies not simply in the inanimate versus the living. Of equal importance is that physical despoliation can be reversed while the loss of biodiversity cannot.

Humanity is heir to the richest biodiversity of all geological time. For nearly 4 billion years, despite occasional pauses and setbacks, life has grown in diversity at every level of classification. One of the steepest ascents began about 150 million years ago with the takeover of the land by flowering plants and their insect partners.

During hunter-gatherer times, human beings started to reduce biodiversity from its all-time high. Now modern societies have extended humanity's lethal reach through the outright removal of entire natural habitats, such as the nearly complete deforestation of the Philippines, Ivory Coast, and Ecuador. The introduction of exotic plants and animals into surviving reserves has hastened the decline. All in all, the growth of human populations and the spread of contemporary technology have catapulted the loss of biodiversity to its highest level since the extinction of the dinosaurs some 66 million years ago.

The exact rate of current extinction cannot be precisely assessed, because so many kinds of organisms have never been classified. An astonishing gap exists in our knowledge of the present biodiversity. No one knows even the order of magnitude of the number of species of living organisms. Biologists have bestowed latinized names on 1.4 million species, but most researchers agree that at least 10 times that many kinds of insects and other invertebrates live in tropical rainforests alone. Most flower-



*Biodiversity ensures
human knowledge,
pleasure, wealth,
and survival.*

ing plants have been discovered and named, but the flora of a few remote places, such as the Chocó region of Colombia, remain largely unexplored. Even novel big animals turn up regularly: a new species of beaked whale was described in 1991. And the diversity of visible organisms may be dwarfed by that of bacteria. Recent biochemical tests have revealed that several thousand species, almost all unknown to science, occur in a gram of typical temperate forest topsoil.

But it is in tropical rainforests, which most students of biodiversity believe contain more than half of all species of plants and animals, where we might estimate the percentage rate of extinction. Those forests now extend over an area roughly equal to that of the contiguous United States, constituting slightly less

than half their prehistoric cover. During the 1980s country-by-country monitoring revealed that the forests were being destroyed at an annual rate of some 1.8 percent—an area about equal to that of the state of Florida. All signs suggest that a similar level of clearance is continuing. From the known relation between habitat area and species numbers, a general rule established by more than 100 studies, the reduction translates to between 0.3 and 0.7 percent of the species extinguished or doomed to early extinction each year. If there are only 10 million species in the rainforests, the lowest number doomed each year is 30,000.

Should such destruction of the tropical rainforests continue for 30 more years, the species loss in tropical rainforests between now and then will range from 10 to 22 percent. And this projection is optimistic, since it does not account for the still-unmeasurable but substantial losses due to pollution and exotic organisms. Nor does it include the possibility of the obliteration of the last remnants of forests in many countries, which in each instance threaten to wipe out large numbers of species in a single stroke.

Rainforests are merely the largest example of a worldwide crisis. Other studies have documented comparable reductions in many parts of the world, such as in savannas, Mediterranean-type heathlands, old-growth temperate forests, and river systems. Altogether, the species loss over the next few decades could easily amount to 20 percent or more.

Why should we care if so much of the world's fauna and flora die? Because biodiversity, if preserved and used wisely, is a potential source of immense new wealth, scientific knowledge, and esthetic pleasure. Wild species are a proven but still largely unused reservoir of new food crops, domestic animal stocks, pharmaceuticals, fibers, petroleum substitutes, and other products.

They provide vital ecosystem services by balancing the atmosphere, cleansing the water, and bringing soil to life. Not least, biodiversity is part of humanity's greatest heritage: the DNA of each kind of higher organism, put into place through a long and tortuous history, adapts it to a particular niche in the environment with exquisite skill.

A few commentators have waved aside the crisis by saying that humanity is only the latest agent in a natural process of extinction and that evolution will restore the losses. But the rate of extinction is now hundreds to thousands of times greater than it once was, and rising. If geologic history is a guide, about 10 million years will be required for evolution to repair the loss anticipated during the next 50 years.

Preserving Habitats

Outside the fantasies of science fiction, no prospect exists of creating new species or of recreating extinct ones from the DNA of fossils and museum specimens. Nor will the preservation of tissues in liquid nitrogen serve as more than a last resort for a few endangered species. Seed banks, botanic gardens, and zoological parks will help as a safety net for flowering plants and larger animals. But to salvage the vast majority of species, preserving the remaining natural habitats is necessary.

We must begin by speeding the mapping of the world's species. The most effective course will be to focus initially on threatened ecosystems and groups of species, aiming eventually at a complete world survey. The work can best be implemented country by country under the sponsorship of national and multinational biodiversity centers. A model is Costa Rica's new National Institute of Biodiversity, which has begun, with the assistance of foreign specialists, to inventory the country's entire fauna and flora. Semi-skilled collectors are deployed to gather specimens, which are processed at the institute's San José center and then distributed to experts for identification and further study.

More complete biodiversity inventories will offer a better basis for establishing reserves. My own preliminary estimate is that we need to expand reserves—as soon as possible—from 3 percent of the world's land surface to the full 10 percent currently remaining in a habitable and undisturbed condition. This should be in addition to, not in place of, restoring damaged ecosystems on altered land.

The surveys will also enhance efficient economic use of wild ecosystems. Screening can suggest what seed stocks and the like may be of interest for harvesting. It can also indicate what species may have genes that could be useful for developing new drugs or for improving domestic plants and animals.

The highest priority is sustainable development. From tropical forests, for example, pharmaceuticals and other non-timber products can be harvested in perpetuity, while timber can be harvested in 30- to 50-year cycles along contoured strips instead of through irreversible clear-cutting. And if sustainable methods of agriculture and animal husbandry are brought at low cost to the desperately poor where they live, they will not have to move into, and damage, residual wildlands.

Meanwhile, the root of all environmental difficulties—excessive population growth—has to be brought under control. Otherwise all efforts in conservation and sustainable bioeconomics will eventually fail. Every country needs a policy that merges its concept of optimum human-population size with the preservation of its biological wealth.

If we control our own size and avert the extinction of other species, future generations will look on us with admiration instead of justified contempt born of disappointment. ■

EDWARD O. WILSON, a biologist, is Baird professor of science and curator in entomology at Harvard University's Museum of Comparative Zoology. He has received numerous honors in science and literature alike, including the U.S. National Medal of Science and two Pulitzer Prizes. His latest book, The Diversity of Life (Harvard University Press, 1992) was published in October.



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Reviews

BOOKS

THIS IS LIVING?

*Artificial Life: The Quest
for a New Creation*

by Steven Levy
Pantheon, \$25

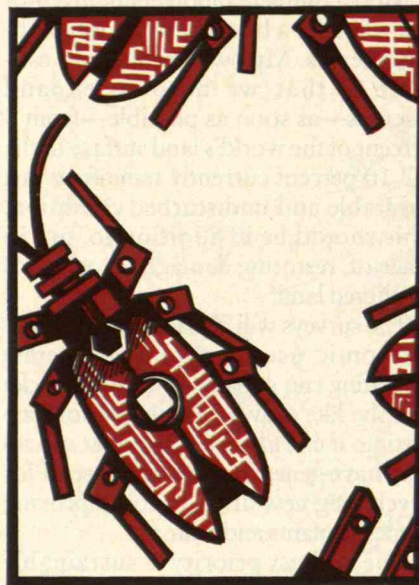
BY G. PASCAL ZACHARY

HAVING found their way inside almost every machine, computers are on the verge of turning upside down the ordinary notion of life. Armed with ever more powerful computers, researchers are trying to make, if not life itself, at least a reasonable imitation.

Today's artificial creatures don't consist of flesh and blood or even carbon. And they are decidedly primitive—nothing more than software simulations of roaches, or thumbnail-size robots that act like ants. But the experimenters foresee great things. "Within fifty to a hundred years a new class of organisms is likely to emerge," says James Doyne Farmer, a former Los Alamos National Laboratory physicist and one of the doyens of this nascent field. "These organisms will be artificial in the sense that they will originally be designed by humans. However, they will reproduce, and will evolve into something other than their original form; they will be 'alive' under any reasonable definition of the word."

This is a tall order. Yet a growing number of biologists, neuroscientists, mathematicians, computer scientists, and electrical engineers have been drawn to this challenge. Some seek to learn more about natural life by studying simulations of it; others, bolder and arguably more reckless, want to create a new kind of life.

It is far too early to guess at the value in either studying or creating such entities. But as journalist Steven Levy shows in his splendidly written *Artificial Life*:



The Quest for a New Creation, the field is a captivating playground for some of the most iconoclastic and creative scientific minds of the times. Levy, who won acclaim for *Hackers: Heroes of the Computer Revolution*, provides the first detailed account of artificial life. He lays a solid foundation for understanding current research by recounting the contributions of forerunners, especially John von Neumann, the hugely influential Hungarian mathematician who first conceived of the programmable computer.

After emigrating to the United States in the 1930s, von Neumann espoused the then radical view that the basis of life is information. Life's essence, in short, was a set of instructions not unlike a computer program. Von Neumann also observed that certain digital programs, which he called cellular automata, seemed to exhibit natural behavior. Perhaps, he suggested, their logic mirrored that of natural organisms, right down to embodying the principle of evolution.

This possibility lay relatively untouched for decades, until vastly more powerful computers and advances in biology, chemistry, and neuroscience rekindled interest in von Neumann's

ideas. His intellectual descendants are today's "A-lifers" and the characters in Levy's tale.

Software Bugs

Consider Randall Beer, a researcher at Case Western Reserve University who has created what Levy describes as the world's "most elaborate simulated electronic insect," a digital cockroach.

Beer's coffin-shaped pest, intended to verify von Neumann's beliefs about the relationship between information and complex behavior, is visible only on a computer screen. But through clever coding, its six legs are capable of a stable gait known among insect watchers as a "metachronal wave," where movements progress from the rear legs to the forward ones. Beer has produced five different gaits by varying the firing of neurons in a simulated nervous system that responds to feedback from the legs. And to his surprise, the roach has grown more and more proficient at running an obstacle course to find food.

Foraging may seem like a modest intellectual achievement even for a cockroach—but then A-lifers are quick to distinguish their goals from those of artificial intelligence. "I'm interested in life, not intelligence," says David Jefferson, a leading A-lifer and a professor of computer science at the University of California at Los Angeles. "Intelligence to me is incredibly exciting, yet a footnote in the history of life."

Jefferson has designed a computer program in which ants seem constantly to improve their ability to follow trails. The ants "reproduce" as the program mixes the traits of different individuals to create offspring, and subsequent generations appear to gain new attributes through mathematically induced random selection.

Jefferson's experiments are little more than clever video games, yet they hint at the field's possibilities. By duplicating pieces of lifelike behavior, says evolutionary biologist Richard Dawkins, artificial life may be "a generator of insight in our understanding of real life."

To A-life enthusiasts, this is just the beginning. One engineer wagers that "within a decade" he will build a robot that behaves so much like a dog that "for all practical purposes" it will be a dog. "Nothing is done by nature that can't be done by computer," asserts another researcher.

These aren't even the most intemperate pronouncements coming from A-lifers. Rodney Brooks and colleagues at MIT's Mobile Robot Group—whose motto is "fast, cheap, and out of control"—see artificial life finding a home in environments that are hostile to people. They envision an alien planet swarming with artificial life forms, autonomous robots that adapt, learn, and cooperate with one another and pave the way for human astronauts. These robots might resemble tiny bulldozers, leveling an area of terrain and piling soil for later analysis. They might even obtain a kind of separate but equal status with biological life on earth. Programmed with the knowledge of how to build their successors, the robots could reproduce over the centuries and evolve into fresh forms through adaptation and random selection.

Militant A-lifers desire more than a galactic ghetto for their creatures, though. Brooks speculates that insect-level robots "have the potential to change our daily lives in much the way microprocessors have" by taking over tasks in, say, manufacturing or construction. Other researchers are audacious enough to suggest that in time some A-life concoctions might show more intelligence or durability than nature's own bounty. "Some of these scientists are genuinely enthusiastic about the possibility that their labors will eventually lead to the extinction of the human race," Levy writes.

Manufactured Threats

But don't lose sleep yet. Today's A-life creatures are better suited as Disney World characters than as messengers of

the Apocalypse. Indeed, the gap between the predictions made by A-lifers and the actual content of their experiments is so large that there's no wonder skeptics confidently uphold organic chemistry as essential to life.

While artificial-life proponents might be right to label such critics "carbaquists" (people unwilling to imagine non-carbon-based life forms), they are premature in thumbing their noses at disbelievers. Even Levy, pressed for evidence that the future belongs to A-life, concedes that one must make "a leap of faith." He offers the science-fiction writings of Isaac Asimov and other novelists as an odd sort of proof that A-lifers are on the right track.

Yet the immaturity of A-life does not prevent Levy from tying the field to the "fate of the earth" bandwagon. Imagining A-life run amok—displacing species after species—Levy writes: "This inherent potential for catastrophe makes artificial life a horribly risky proposition. . . . One would think that the enormity of this peril—no less than the end of humanity, perhaps even the entire biomass—would evoke a groundswell of opposition to A-life. Yet none has so far emerged."

Such extravagance leaves Levy open to charges of practicing an old journalistic con game: herald a new fear as a way to win the gratitude of readers. The hypothetical fears inspired by A-life pale beside more palpable worries—nuclear and chemical weapons proliferation, the threat of global warming, or even the release of biologically altered living creatures into the environment.

Still, Levy is doing what reporters do: listening. And in this case he hears the siren song of the scientists and records the perverse hubris that compels one researcher to compare A-life to nuclear weapons. Creator of worlds, shatterer of worlds—this is an unfortunate model to impose on a child science. ■

G. PASCAL ZACHARY is a staff reporter with the Wall Street Journal. He is writing a biography of Vannevar Bush, the computer pioneer who served as science adviser to Franklin Roosevelt and as president of MIT.

BOOKS

CULTIVATING HIGH-TECH WEAPONRY

Flying Blind: The Politics of the U.S. Strategic Bomber Program
by Michael E. Brown
Cornell University Press, \$47.50

BY DAVID CALLAHAN

WITH the end of the Cold War, one can expect to hear a lot less debate about weapons procurement and Pentagon reform. As the Department of Defense voluntarily cancels arms programs, and the U.S. military effort declines, the golden era of security analysis is obviously over. At first glance, it is therefore easy to feel a surge of compassion for Michael E. Brown, a senior research fellow at the International Institute for Strategic Studies in London, who has labored for years—starting in the mid-1980s, when the Cold War was still going strong—on *Flying Blind*. This book on the politics of the U.S. strategic bomber program had the misfortune of being published in the same year Congress and the Pentagon agreed to build no more strategic bombers after the production run of 20 B-2 stealth warplanes is completed.

But Brown's findings are far from irrelevant. The main purpose of *Flying Blind* is to investigate why and how the Pentagon acquires the weapons it does. This topic, alas, is of enduring timeliness. Although the Cold War has ended and the armed services are under pressure to spend defense dollars wisely, current Pentagon plans call for spending over \$2 trillion in the 1990s. The issue of defense reform, in short, is not going away.

Brown identifies two questions at the center of the arms procurement puzzle: First, how do weapons programs origi-

nate? And second, why are they often managed so poorly? Finding answers is essential if the perennial quest to save otherwise wasted billions is ever to succeed.

Students of national security affairs have advanced a number of arguments for why weapons programs are initiated. The most straightforward of these is that the armed services pursue new weapons to deal with anticipated threats. This strategic explanation holds that developments in world politics ultimately guide defense policy.

A second popular view is that bureaucratic politics shape weapons decisions. Under this explanation, each branch of the military works relentlessly to expand its domain, fighting for new missions and larger budgets. More broadly, the defense establishment as a whole seeks to maintain its slice of the federal budgetary pie. These parochial concerns, the argument goes, are often more decisive in shaping weapons decisions than the national interest.

The two other major explanations for how weapons originate are economic and technological. The rather cynical economic explanation is that defense contractors initiate new weapons programs and then convince the Pentagon to push ahead with them. A more subtle version of this view is that the government commissions new weapons to maintain the U.S. defense industrial base, which presumably would wither in the absence of a steady stream of projects.

The technological explanation holds that a strong impetus for new weapons is breakthroughs in technology. Pentagon officials, it is said, want sexy, futuristic weapons so badly that they devise new and often far-fetched military missions to justify them. Again, national interest is not the driving force.

Shooting Down Myths

Which explanation is right? Looking at 15 different strategic bomber programs over 50 years, Brown finds "no significant support for the widely held view that technological and economic factors are responsible for triggering most



weapon development programs." Instead, he says, there is "some support for bureaucratic arguments and a great deal of support for strategic explanations of these weapons decisions."

Brown is quite convincing in his analysis. Technological factors could not possibly have driven most new strategic bomber programs, he says, because the technology for these programs was usually not yet developed when they were conceived. Often, it was the design of new bombers that triggered breakthroughs, not vice versa.

Brown is even more dismissive of economic factors. He finds no evidence for the view that entrepreneurial contractors persuaded the Pentagon to begin strategic bomber programs. Instead, Brown writes that as a general rule "the Air Force took the initiative, established development programs, and then contacted defense contractors about participating in them." Neither does Brown see any truth to the charge that the Pentagon doles out contracts to keep defense firms healthy. In every case he analyzes, he concludes that contract awards were based on a company's performance. There is no welfare program for defense contractors, he suggests.

While generally sound, Brown's findings on economic factors will not neces-

sarily hold true in the future. Since the late 1980s, there has been much talk about how to keep the defense industry alive after the Cold War. Pentagon officials and other analysts have argued that without new weapons programs, certain key companies will go under and their production facilities and skilled workers will be lost forever. This line of argument is likely to gain influence in shaping weapons policy in the years to come.

Brown confines his critique of economic factors solely to the initiation phase of weapons programs. This is unfortunate, for a book that purports to explain the politics behind strategic bombers would clearly profit from an in-depth exploration of the economic momentum that tends to gather behind large weapons programs. It has been commonly said, for example, that the Pentagon sought to make the B-1B "invulnerable" by sprinkling subcontracts in as many states and congressional districts as possible. Is this why the program survived so many efforts to kill it in the 1980s? Brown provides no answer and never looks at the pork-barrel issue in any serious way. Indeed, Congress is an absent player in much of this book, despite its major role in almost every phase of weapons acquisition.

The Multibillion-Dollar Question

Brown's analysis of bureaucratic and strategic factors also has limitations. It is accurate to observe, as Brown does, that the Air Force had a huge bureaucratic stake in promoting and sustaining the idea that long-range bombers were critical to U.S. national security. Likewise, he is on solid ground when he argues that strategic developments—such as advances in Soviet air defenses and nuclear arms—were the main driving force behind the U.S. strategic bomber program. Yet something is missing. Brown never really answers the multibillion-dollar question, Why did the United States continue to obsess so much about its strategic bomber force once ballistic

missiles were developed? A warplane based in the United States takes many hours to reach its target and is vulnerable to air defense. Intercontinental ballistic missiles can destroy a target in 30 minutes and are basically unstoppable.

That a strategic triad of weapons based on land, at sea, and in the air increases the overall "survivability" of the U.S. nuclear arsenal is common knowledge. So is the idea that strategic bombers are useful because they can be recalled once launched, and thus can be used to signal American resolve in a crisis. But even these points cannot fully explain why the United States plowed on with the wildly expensive B-2 stealth bomber program.

Brown does not delve deeply into the world of U.S. nuclear strategy, but here is where the missing piece of the puzzle lies. In the 1970s and 1980s, penetrating bombers were seen by Pentagon planners as integral to plans for protracted nuclear war. It was not enough to rely on cruise missiles that could be launched from outside of Soviet airspace by B-52s. Nor were B-1B bombers that could be seen by radar fully dependable. Only the B-2 would be capable of flying undetected over the Soviet Union to hunt mobile missiles and pick off other targets that might survive the first salvos of a nuclear war.

A look at the evolution of U.S. nuclear warfighting plans and the role of manned bombers in such plans could have been fascinating. But Brown doesn't undertake this task in any detailed way, and his book suffers as a consequence.

Flying Blind concludes with some useful observations on how to better manage weapons programs. The main lesson Brown draws from his case studies is that the Pentagon should not jump into projects that entail too many technological uncertainties. This happened a number of times during the history of the U.S. strategic bomber program, and billions of dollars were wasted as a result. The Air Force is not the only service to have made this error. In 1985, for example, Secretary of Defense Caspar Weinberger canceled the Army's Sergeant York anti-air-

craft gun after nearly \$2 billion in expenditures because it proved too complex.

A key reason for the Pentagon's high-tech obsession during the Cold War was its desire to build weapons that would not quickly become obsolete. Brown notes that because future Soviet threats were often unclear, Air Force planners were typically guided by worst-case assumptions; they sought the most advanced military technology possible as a hedge against Soviet breakthroughs that might be even more awesome. With the end of the Cold War, this kind of speculative planning is no longer necessary. To avoid "flying blind," the Pentagon will have to proceed less hastily and place more emphasis on developing and testing prototypes. Already, Pentagon officials are publicly embracing this approach. The United States may finally have the breathing room to make sure the weapons it procures are really needed and are based on technology that works. ■

DAVID CALLAHAN is author of *Dangerous Capabilities: Paul Nitze and the Cold War*. His article "The F-22: An Exercise in Overkill" appeared in *TR*, August/September 1992.

BOOKS

AID AND DISCOMFORT

Mastering the Machine: Poverty, Aid and Technology
by Ian Smillie
Westview Press, \$45/\$12.95

BY SUSAN KATZ MILLER

THE image of an abandoned tractor rusting in a field has become a cliché in the aid business, symbolizing the failure to transfer many expensive, fuel-demanding technologies to the impoverished nations of the Southern Hemisphere. The numerous failed attempts at transferring small, "appropriate" technologies are less well



known. In a West African village, I remember seeing Senegalese women standing at a well, hauling up buckets of water by hand, while a rusting pulley hung, unused, over their heads. The pulley was an earnest attempt by a Peace Corps volunteer to make the villagers' job easier. But the women found that it required using a different set of muscles, and they refused the aid of this simple and seemingly appropriate technology.

In 1973, economist E.F. Schumacher published *Small Is Beautiful*, which promoted the use of simple, cheap, and non-violent technologies in the South. Schumacher predicted that the process of alleviating poverty with "intermediate technologies" would not be long, expensive, or difficult. In this, he was wrong. And when the process proved arduous, the appropriate-technology movement he inspired came under attack as being unprofessional, unanalytical, and driven by desires to build a better mousetrap without responding to the demands of the marketplace.

In *Mastering the Machine*, Ian Smillie mounts an articulate defense of the appropriate-technology movement in its current incarnation. At the heart of the book are case studies of dozens of appropriate-technology efforts. In many of them, Smillie describes how patience,

innovation, and closer attention to the needs of beneficiaries rescued such projects as a vegetable drier in Peru and a fuel-efficient stove developed in Thailand and adapted for Kenya.

But Smillie does not shy away from dissecting complete failures, including a brickmaking machine in Botswana, sugar manufacturing technologies in Kenya, and micro-hydropower projects in Sri Lanka. Development organizations, which rely on donor support, usually avoid conducting public post-mortems of failed projects. Thus it is particularly enlightening to hear these stories from Smillie, a development consultant and insider in the aid business.

For Smillie, the phrase "technology transfer" itself reflects the deeply flawed concept that technology is "something neutral, something that exists outside of society." When development agencies

harbor this illusion, irrigation pumps and oil presses land in villages like interesting but irrelevant flying saucers. Again and again, Smillie makes his point: "The cultural, historical, and organizational context in which technology is developed and applied is the key to its success or failure."

Smillie also notes that the North's interest in disseminating the fruits of technology has been egregiously one-way. Although as early as 1968 a World Bank document (the Pearson Report) asserted that industrialized countries would have to remove barriers to imports from developing countries, Smillie points out that Northern trade barriers have tended to rise as Third World production has grown. Textiles are a particularly grievous example: quotas imposed by the United States, Canada, Great Britain, and France in 1985 forced the closure of 500 clothing factories in Bangladesh alone. The South, Smillie writes, may be in for "a long downward spiral of belt-tightening in the face of intractable Northern trade policies."

Smillie glosses quickly over the well-known ills inflicted by aid from multilateral agencies such as the World Bank and the U.N. and from Northern governments. Instead, he focuses on the many non-governmental organizations (NGOs), from big American-based relief and development agencies such as CARE to the indigenous NGOs that have recently proliferated in the South. He lauds the flexibility of these private voluntary organizations while decrying their lack of patience with projects and their tendency to reinvent the wheel.

Where Credit Is Due

Although Smillie's appraisal of development organizations is usually on target, I was disturbed by his repeated criticism of one strategy popular among NGOs: providing small loans to villagers who otherwise cannot get credit. The success of the original Grameen Bank, a credit program for women in Bangladesh that was the brainchild of economist Mohammed Yunus, is now being repli-

cated throughout the world.

Smillie brands these village banking schemes "minimalist," in part because they do not create new jobs or push recipients beyond traditional livelihoods such as fattening cattle. Yet the credit programs do improve family living standards. One reason they work so well is that the loan recipient decides for herself how best to spend the aid money. The author's lack of confidence in this method, coupled with language such as the need to "rescue" the poor from "stunted lives of permanent misery," is bound to be interpreted by some Southerners as patronizing.

But generally, *Mastering the Machine* is a superb overview of the development business. It makes a fine complement to two other recent successful books in a similar vein. One, Robert Klitgaard's *Tropical Gangsters*, is a highly personal account of the travails of a development worker in Equatorial Guinea, with a frivolous subplot about finding good surf on the African coast. The other is *Lords of Poverty* by journalist Graham Hancock, an "expose" of aid disasters and extravagant World Bank parties. Smillie tackles subtler issues with greater insight, and without the impassioned rhetoric.

The most obvious message in Smillie's case studies may be that development is almost never easy. While living in Africa, I encountered many aid workers who had arrived on the continent as idealists, only to become hard-bitten cynics. They had abandoned hope of helping the poor, but they stayed on in the business because they liked the lifestyle or thought they could at least do "damage control" on development projects gone awry. Their vision had dwindled to the most basic tenet of the Hippocratic oath: "First, do no harm." For bitter development experts, as well as most other interested parties, this book could bring new energy and ideas. ■

SUSAN KATZ MILLER is a U.S. correspondent (in Washington, D.C.) for *New Scientist*, the British weekly. She worked as a free-lance journalist in West Africa from 1987 to 1990.

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own conclusions about whether to act now to alleviate greenhouse warming. But if they choose to wait, it should not be because they are counting on the imminent emergence of "good data and good models," or because they have been misinformed about the cooling effects of Mount Pinatubo.

JAMES S. RISBEY

PETER H. STONE

Center for Global Change Science
MIT

Turn the page from the John Sununu interview and you learn that the Pentagon is poised to spend \$98 billion on a new fighter jet that will serve no military purpose. Turn again and you read that the industries developing electric vehicles are finally maturing—thanks in part to lightweight composites and other materials that have no doubt resulted from military projects.

Wouldn't composites, potent batteries, fiber optics, high-definition television, and other technologies reach the market more quickly and less expensively if Washington invested in them for their sheer economic potential instead of pretending that the only motive is a strong military? Sununu, bogged down in politics and semantics, says no. Scientists and economists would say yes.

MITCHELL BORETZ
Upland, Calif.

DINO ERROR

One small correction to the kind and thoughtful summary of the Dinosaur Society's efforts to fund research and upgrade products ("The Truth About Dinosaurs" by Debra Rosenberg, *TR* August/September 1992). Tyrannosaurus rex lived more than 60 million years after stegosaurus, not before as the photo caption suggests. Neither is around to complain, however.

DON LESSEM

President

The Dinosaur Society
New Bedford, Mass.

Classifieds

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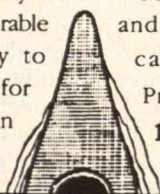
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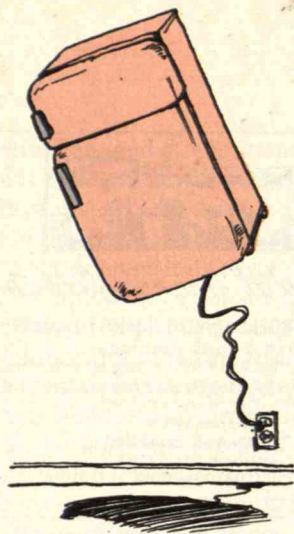
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Notes



World's Lightest Solid

Researchers at Lawrence Livermore Laboratory have taken the concept of lightweight materials to the limit by developing a marshmallow-like foam that they claim is lighter than air. Dubbed "Seagel" (safe emulsion agar gel), the material is composed primarily of agar, a seaweed derivative often used as a thickening agent in food. Once the agar is extracted, dissolved in water, combined with special solvents and emulsifiers, and freeze-dried in a partial vacuum, the resulting foam weighs 1.1 milligrams per cubic centimeter, or about 10 percent less than room-temperature air at 50 percent relative humidity. Only the ambient air that slowly enters the open, microcellular structure keeps the material from floating away.

The foam is fragile in its lighter-than-air composition. But when produced in higher densities, it can support thousands of times its own weight and can be machined like wood, says senior research scientist Robert L. Morrison. He speculates that the material could be used as a substitute for balsa wood—and used, for example, as supertanker insulation or sound-deadening insulation in railcars—as balsa wood is becoming scarcer and more expensive. "A number of

companies have expressed interest in developing low-cost, biodegradable packaging and insulation products from the material," says Morrison. "Drug companies are also interested in it as an encapsulant for medications because of its ingestibility and time-release properties."

Not Better, Just Different

Men are better navigators than women, right? Wrong, says psychologist Thomas Bever of the University of Rochester. "The literature is full of studies showing that males have better spatial abilities," he says. "But men and women can find their way around equally well; they simply go about it differently." Women tend to rely on specific visual cues or landmarks such as buildings, bridges, or trees, he says, while men use "dead reckoning," and think in terms of direction and distance.

Bever tested subjects by running them through a maze of tunnels beneath the university's campus. Both sexes nego-



tiated the maze in about the same amount of time. But when asked to reconstruct the routes from pictures of certain landmarks in the tunnels—such as splotches of green paint on the wall, vending machines, pipes—and to identify the exact location of the landmarks, women performed significantly better. Men, on the other hand, were much better at recogniz-

ing and reproducing a conceptual design of the maze.

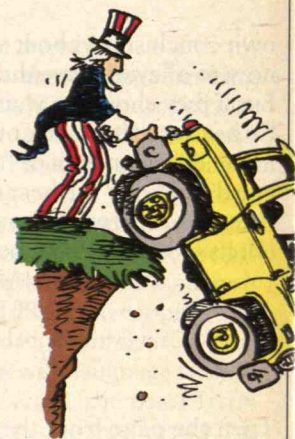
These and other results suggest that the popular theory "that men have a better sense of direction because they were hunters while women were merely gatherers is nonsense," says Bever. Instead, he speculates the differences may be related to the fact that females see better as infants and thus learn to use visual cues to get around. He also points to studies showing that men may be more sensitive to their own heart rate and, therefore, to the passage of time. So they may learn to rely on representations of their surroundings based on distance per unit of time.

Color-Copy Protection

Forgery involving color copiers, computers, and other high-tech equipment soared by an order of magnitude—from about 3,000 to nearly 30,000 cases—in the United States during the last three years, according to FBI figures. But that number may soon be on the decline if Canon goes ahead with plans to introduce a color copier that refuses to reproduce paper currency. The company has reportedly developed a read-only memory chip containing the images of a variety of bank notes and paper money. If a user tries to copy one of the images stored in memory, a protection feature would instruct the machine to either shut down or print a blank copy or message. Canon says it hopes to begin offering the chip next year as an option.

Clunker Compensation

The quickest, surest, and most cost-effective way to reduce urban air pollution, according to a recent report from the U.S.



Office of Technology Assessment (OTA), is simply to junk the nation's oldest cars. This conclusion holds, says OTA, even if owners are paid far more for the clunkers than they're worth just to get them off the road.

The OTA is targeting older vehicles because they account for a disproportionately high percentage of emissions. In fact, the Environmental Protection Agency (EPA) estimates that cars built before 1971 make up 3.4 percent of the fleet and are driven less than 2 percent of the miles, but produce 7.5 percent of the carbon monoxide, 6 percent of the hydrocarbon, and 4.7 percent of the nitrogen-oxide emissions.

Under the OTA plan, owners of pre-1971 vehicles would be paid \$700 for any car that could be driven to a disposal facility. Retiring 1 million of these vehicles, OTA estimates, would annually eliminate 448,000 tons of carbon monoxide, 60,000 tons of hydrocarbons, and 17,000 tons of nitrogen oxides. It would also yield an annual savings of some 182 million gallons of gasoline. Though implementing the plan might cost about \$750 million (factoring in about \$50 per vehicle in administrative costs), OTA says that the program would save approximately \$1 billion.



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